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Van Baelen et al.

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(54) **CABLE DISTRIBUTION SYSTEM WITH FAN OUT DEVICES**

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(65) **Prior Publication Data**

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(51) **Int. Cl.**

G02B 6/44	(2006.01)
G02B 6/38	(2006.01)
H04Q 1/06	(2006.01)

(52) **U.S. Cl.**
CPC ***G02B 6/4452*** (2013.01); ***G02B 6/3897*** (2013.01); ***G02B 6/445*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC .. G02B 6/3897; G02B 6/4452; G02B 6/4471; G02B 6/4457; G02B 6/445;
(Continued)

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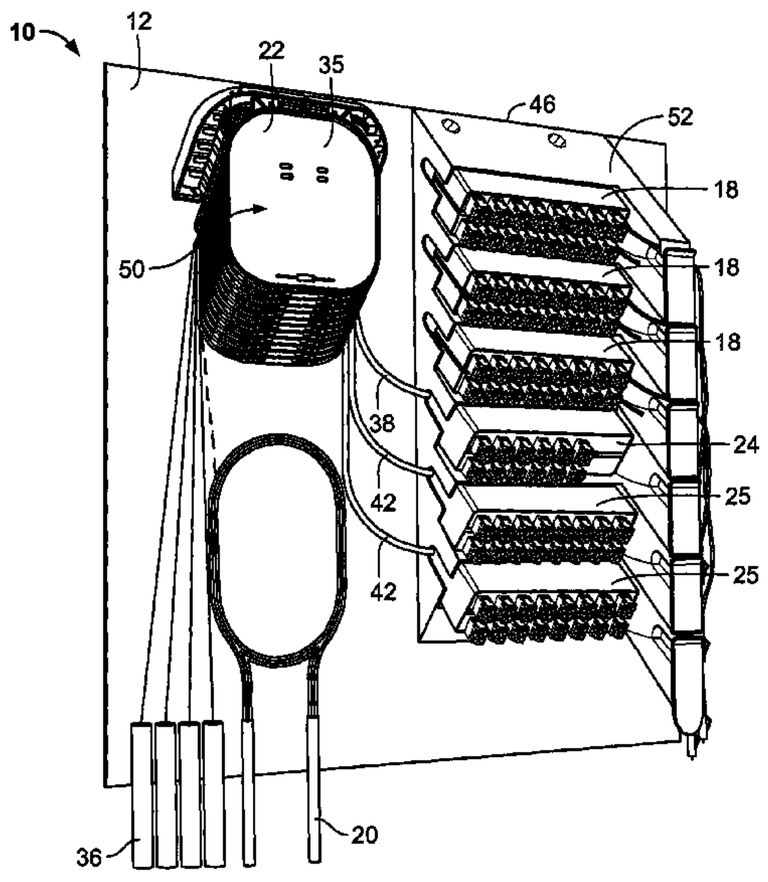
Assistant Examiner — Mary A El-Shammaa
(74) *Attorney, Agent, or Firm* — Merchant & Gould P.C.

(57) **ABSTRACT**

A cable distribution system is provided wherein a feeder cable with one or more feeder fibers is received by a distribution terminal, device, or box. The feeder fibers are spliced to a feeder fan out device. Customers can directly connect to the feeder fan out device by patching between the feeder fan out device and a distribution fan out device that is spliced to a distribution cable. This connection creates a point-to-point connection. Alternatively, a splitter input can be connected to the feeder fan out device wherein the splitter splits the signal as desired into a plurality of outputs. The outputs of the splitters can be in the form of connectors or adapters. The connectors or adapters are then connected to the distribution fan out device, and customers can receive a split signal through the distribution cable that is spliced with the distribution fan out device.

21 Claims, 16 Drawing Sheets



(52) **U.S. Cl.**
CPC ***G02B 6/4455*** (2013.01); ***G02B 6/4457*** (2013.01); ***G02B 6/4472*** (2013.01); ***G02B 6/4473*** (2013.01); ***H04Q 1/06*** (2013.01)

(58) **Field of Classification Search**
CPC .. G02B 6/4455; G02B 6/4472; G02B 6/4475; G02B 6/4473
See application file for complete search history.

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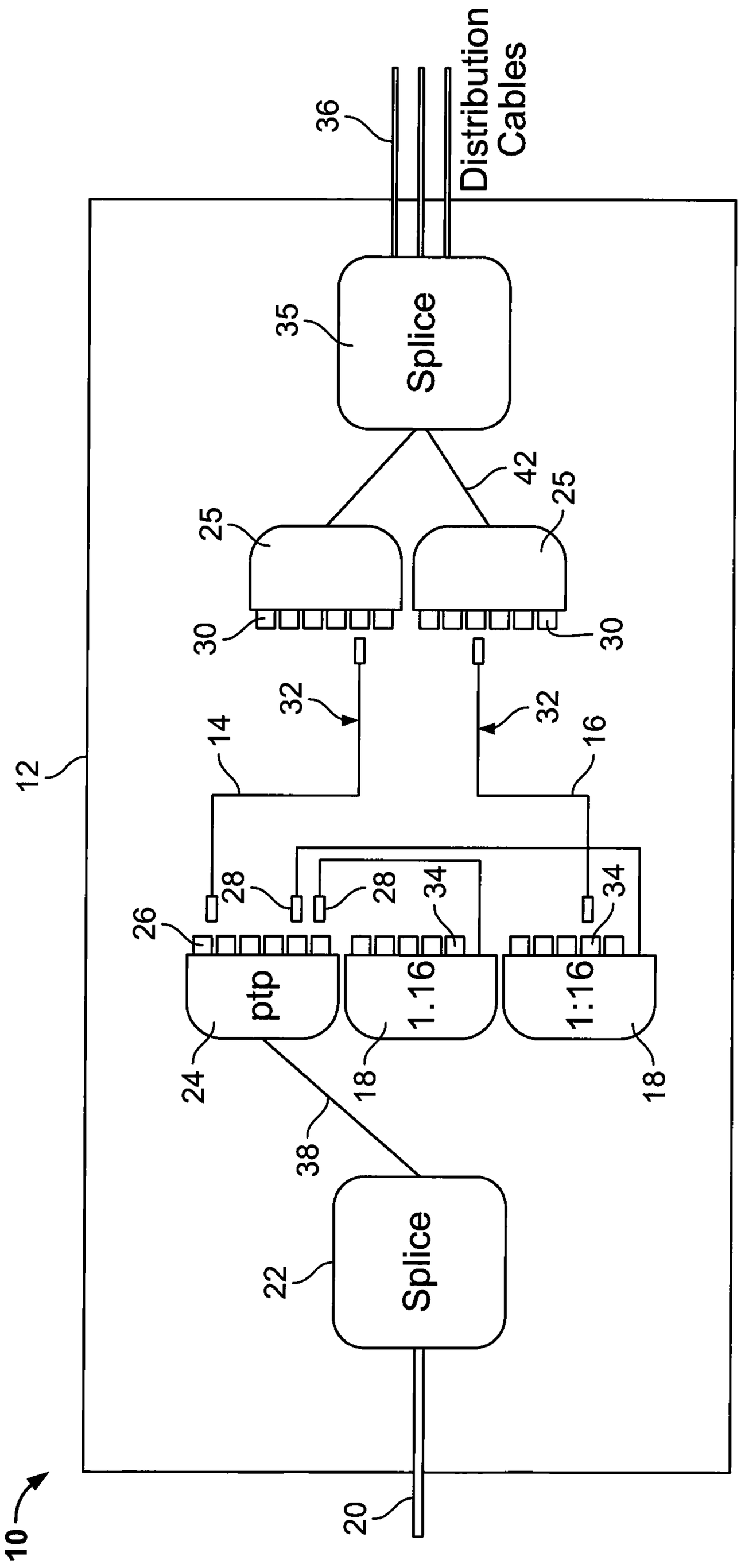
Distribution Cables
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Splice
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FIG. 1

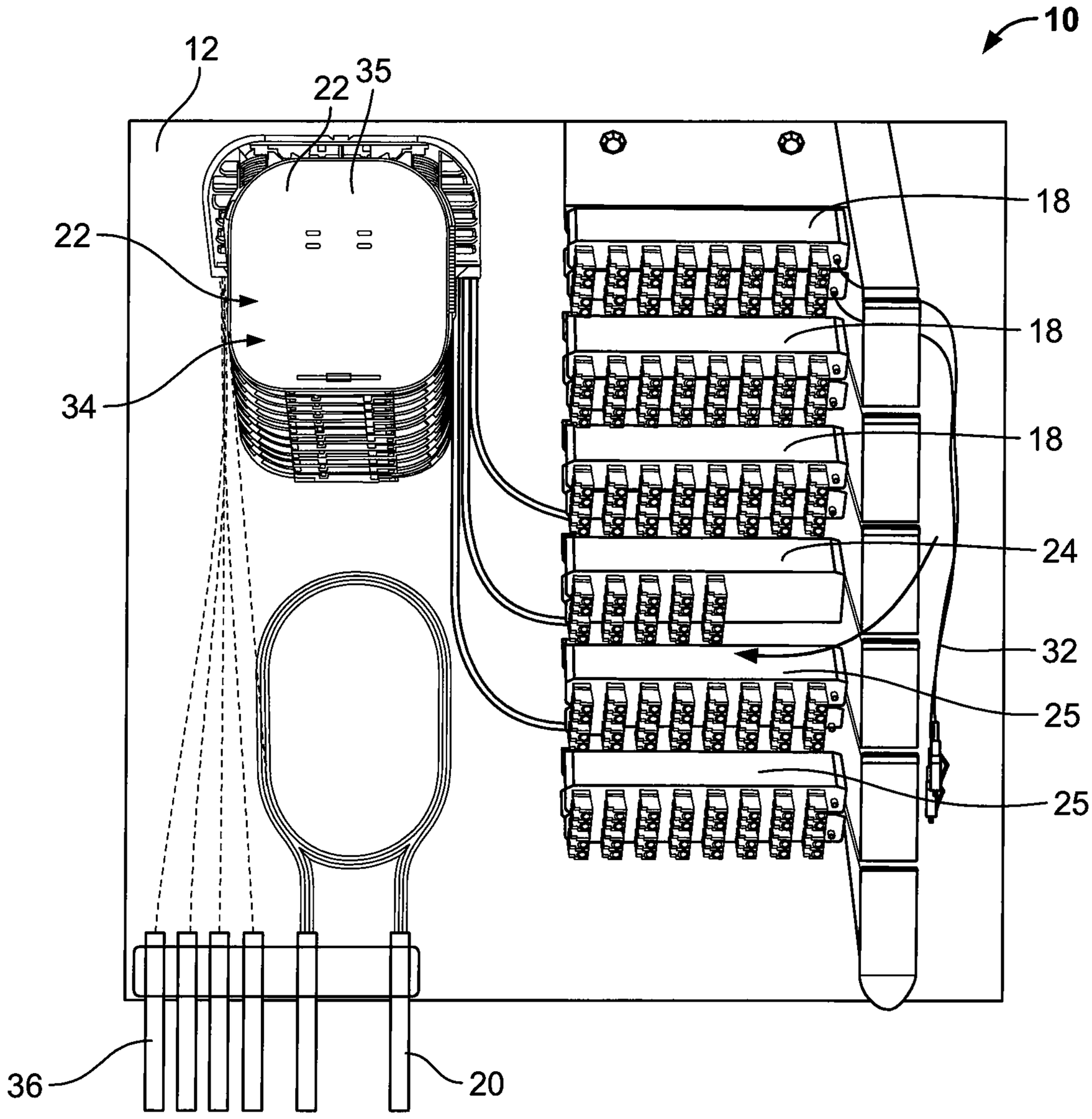


FIG. 2

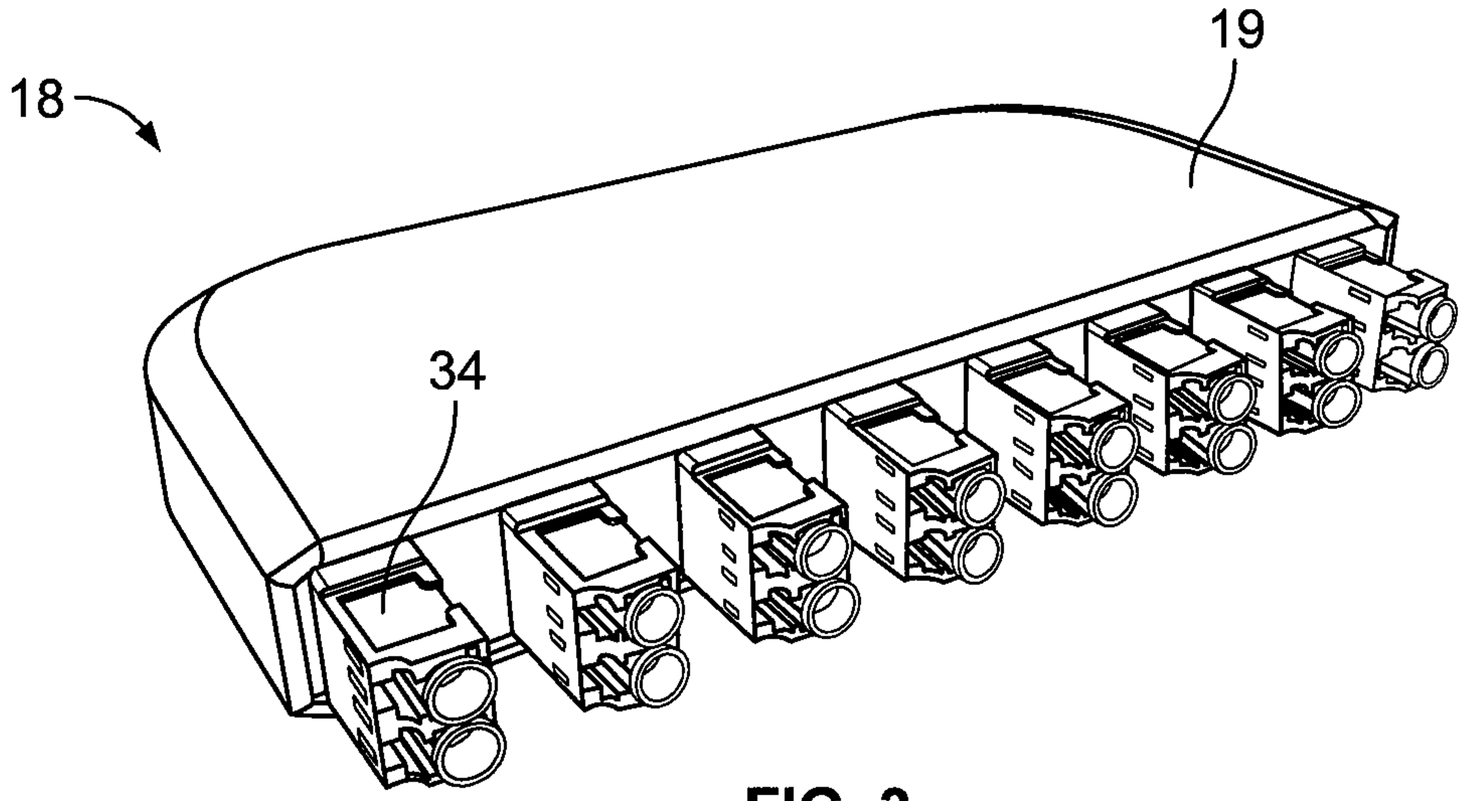


FIG. 3

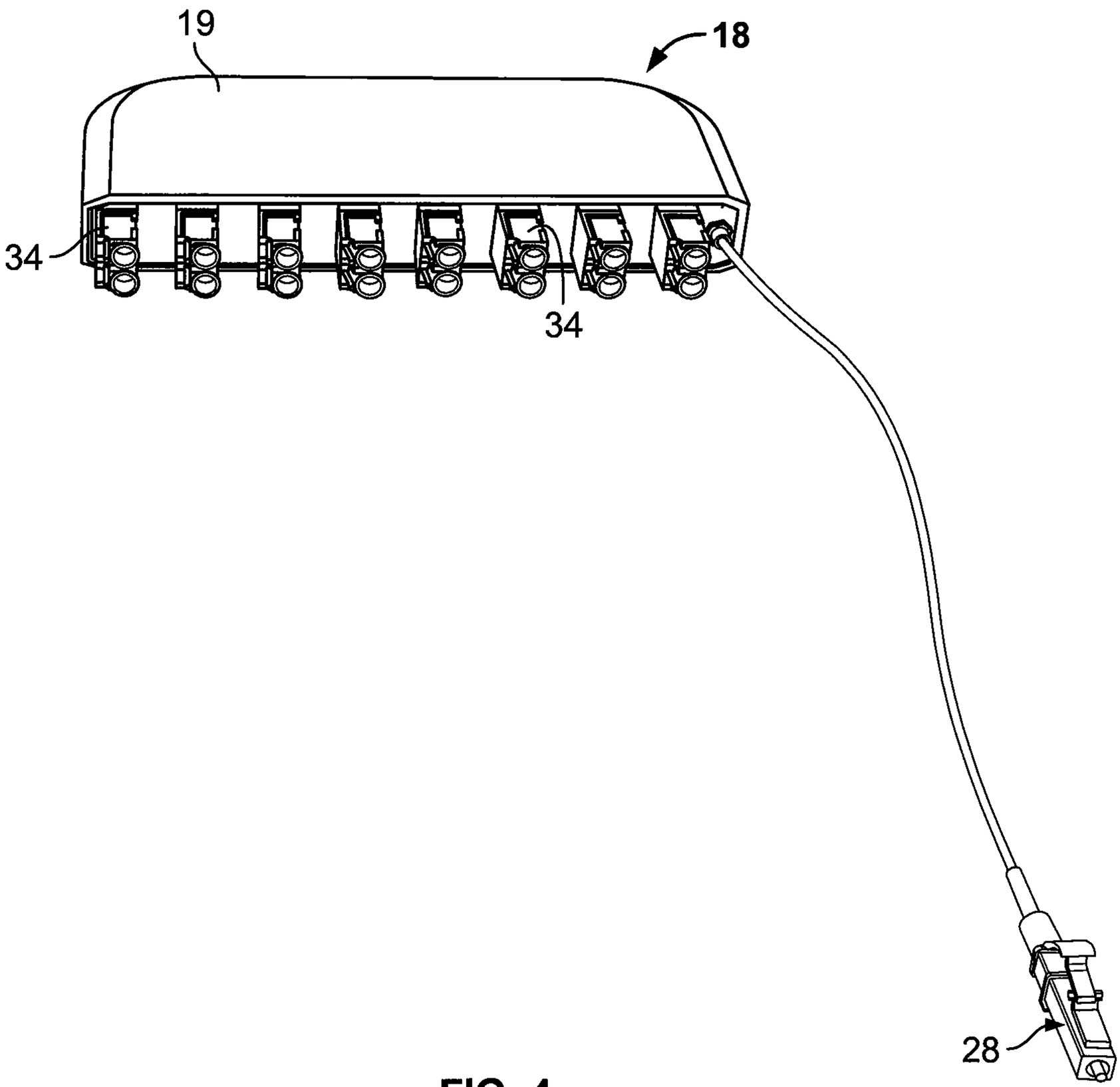


FIG. 4

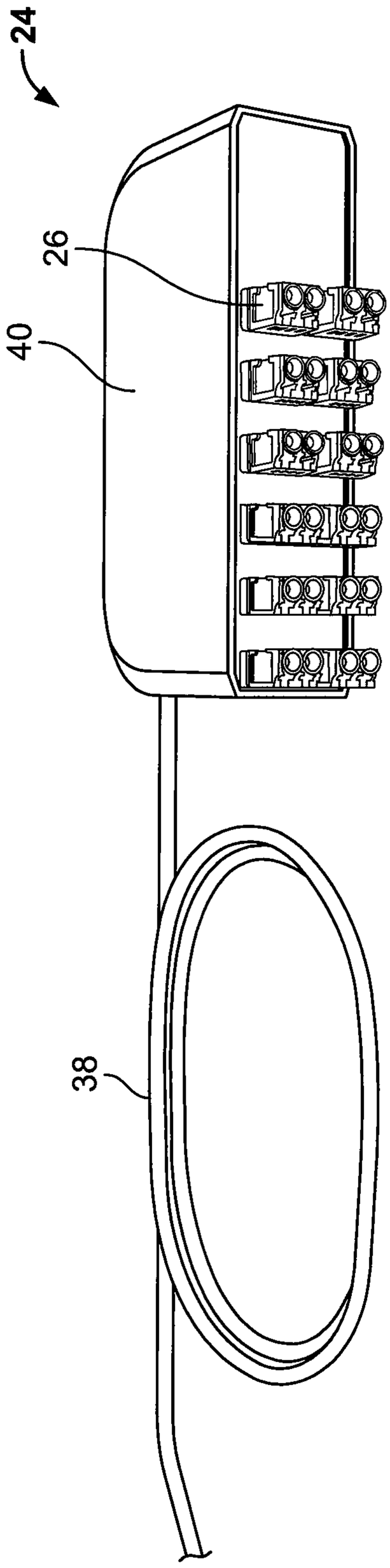


FIG. 5

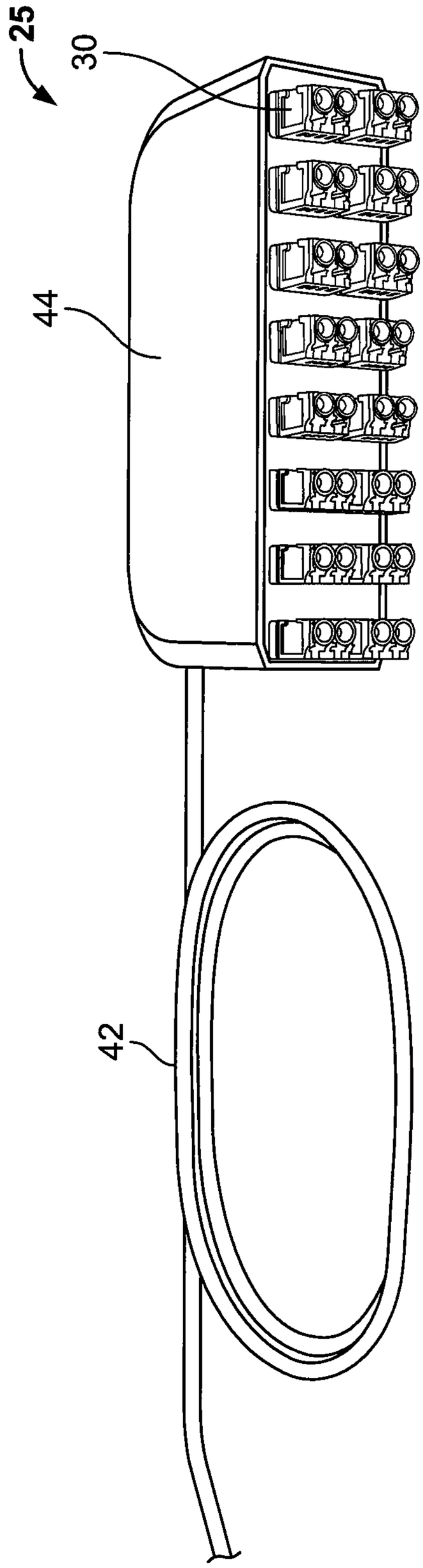


FIG. 6

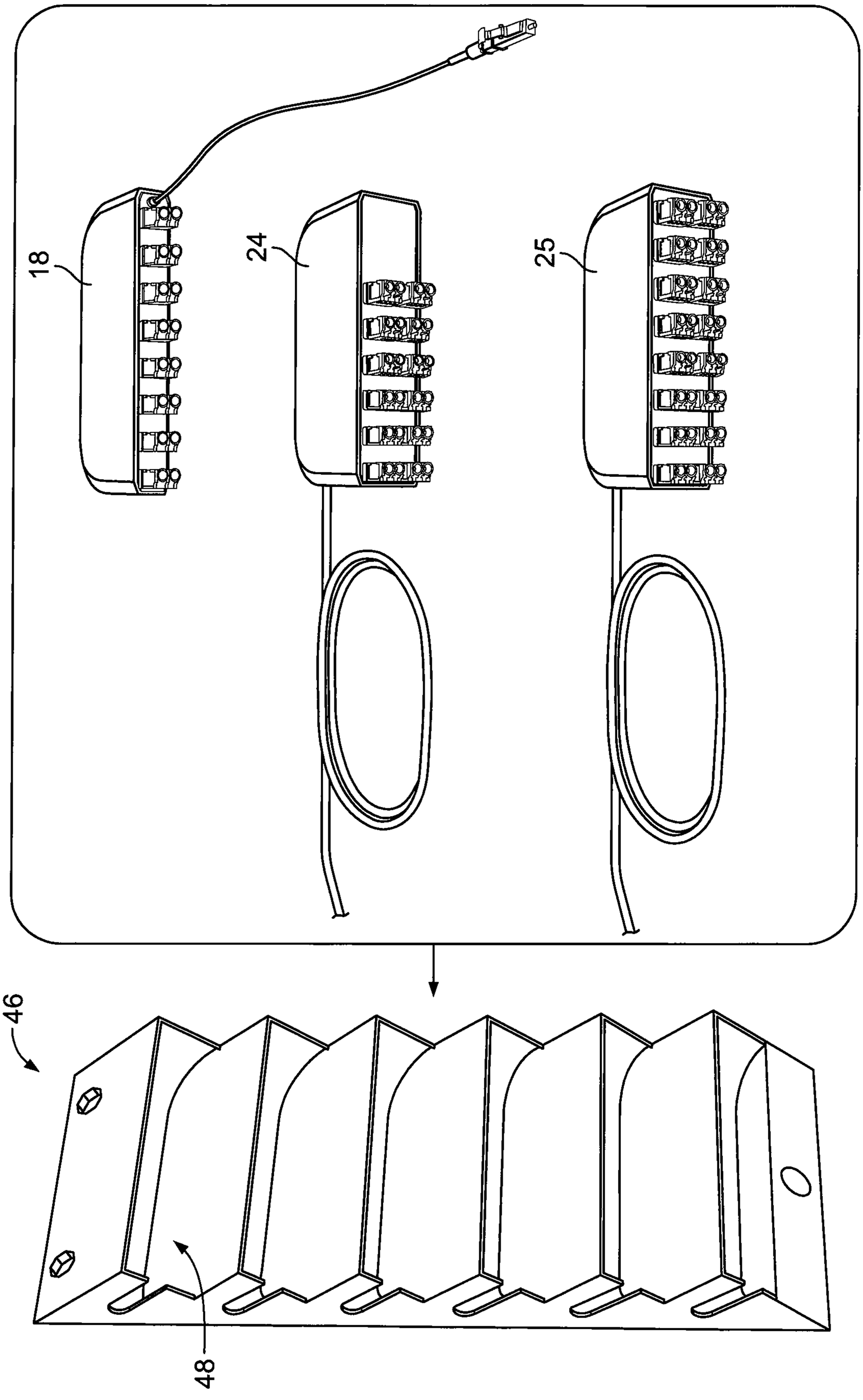


FIG. 7

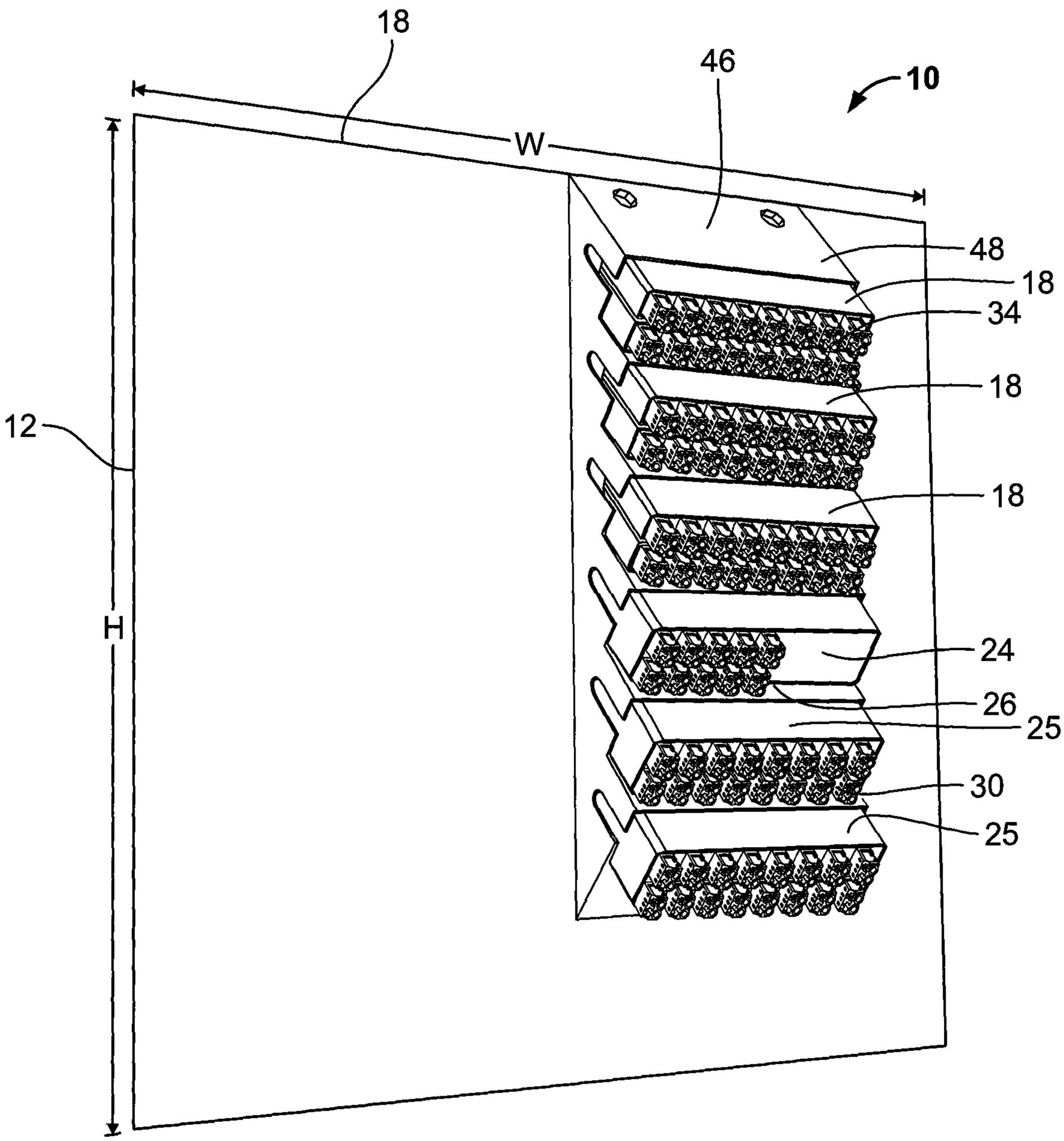
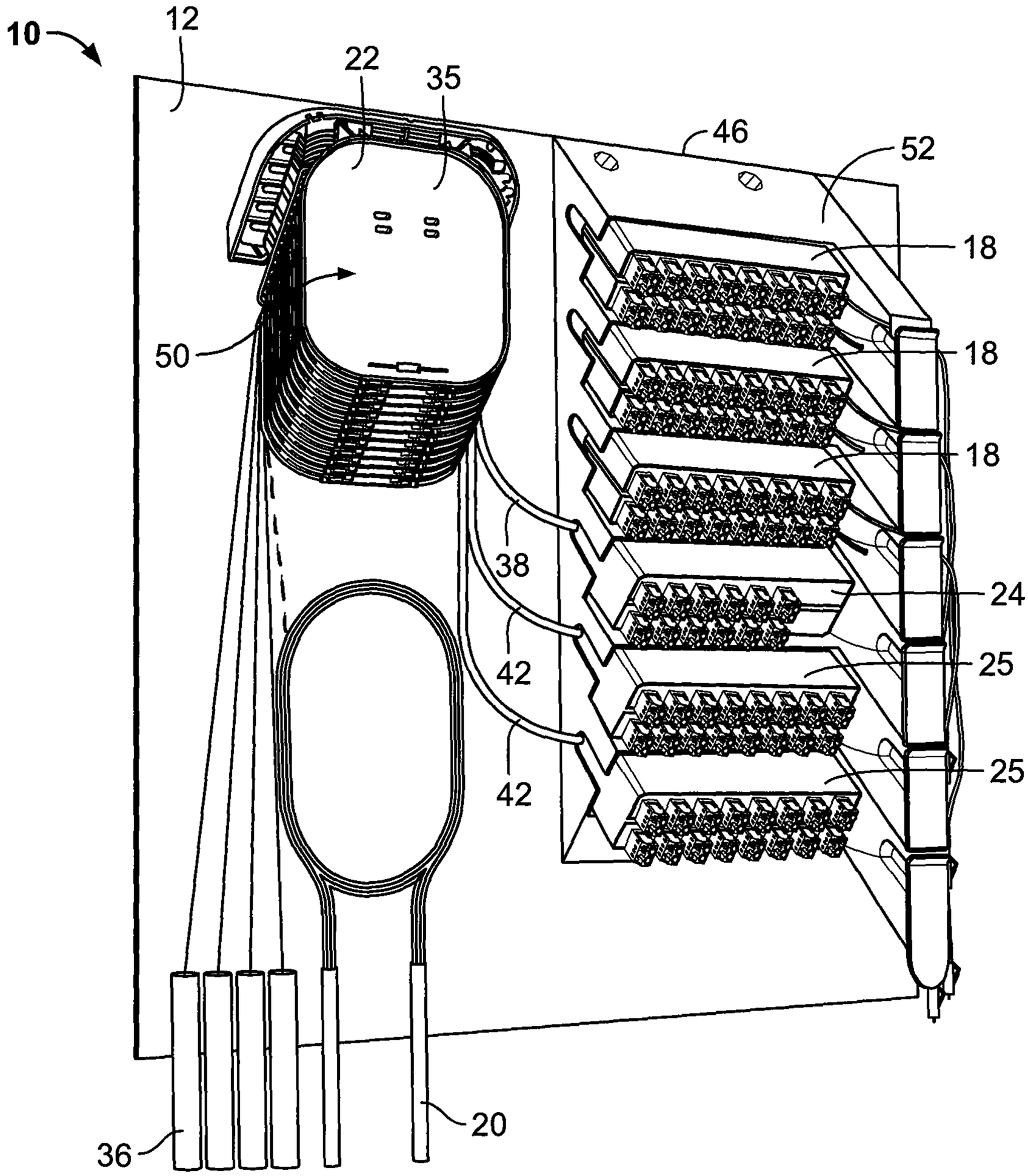


FIG. 8



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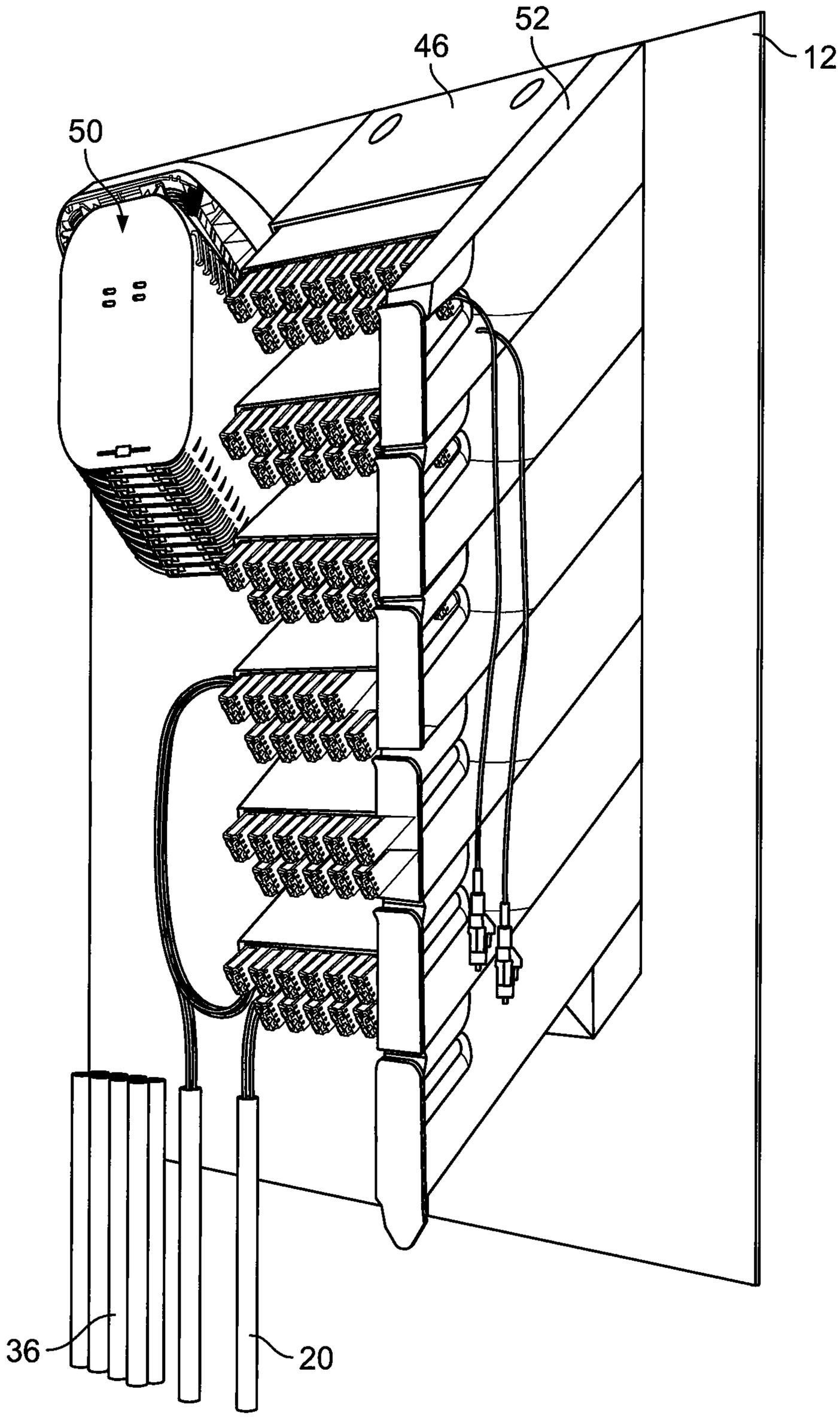
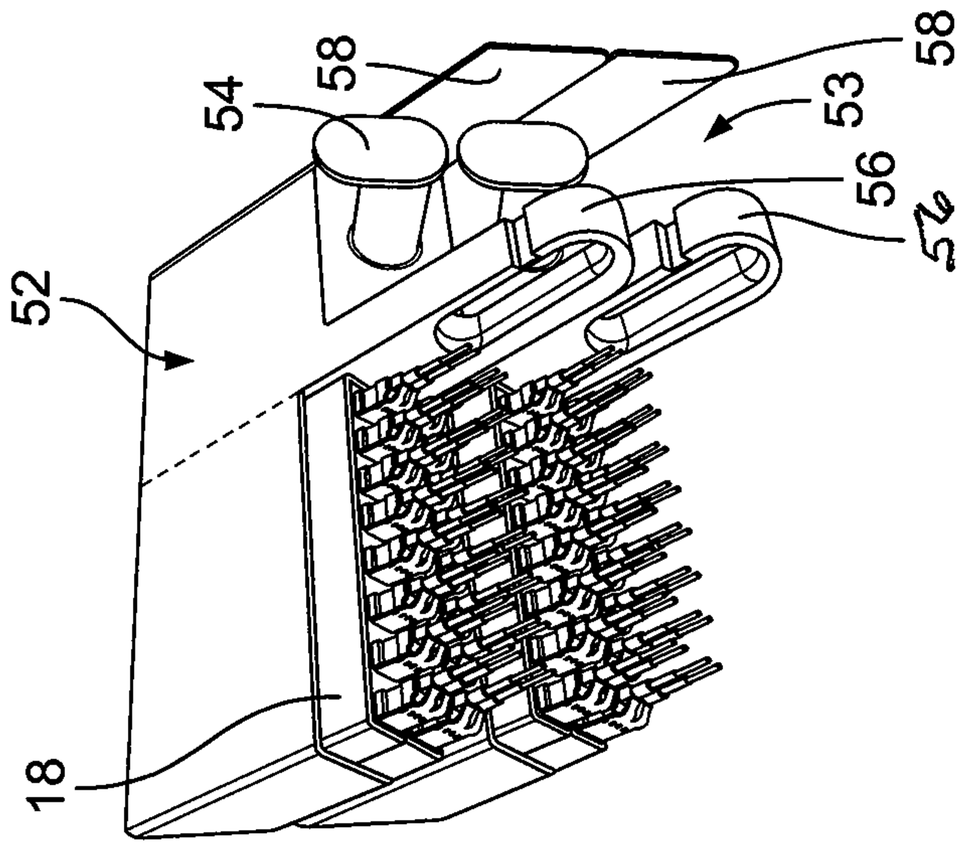


FIG. 10



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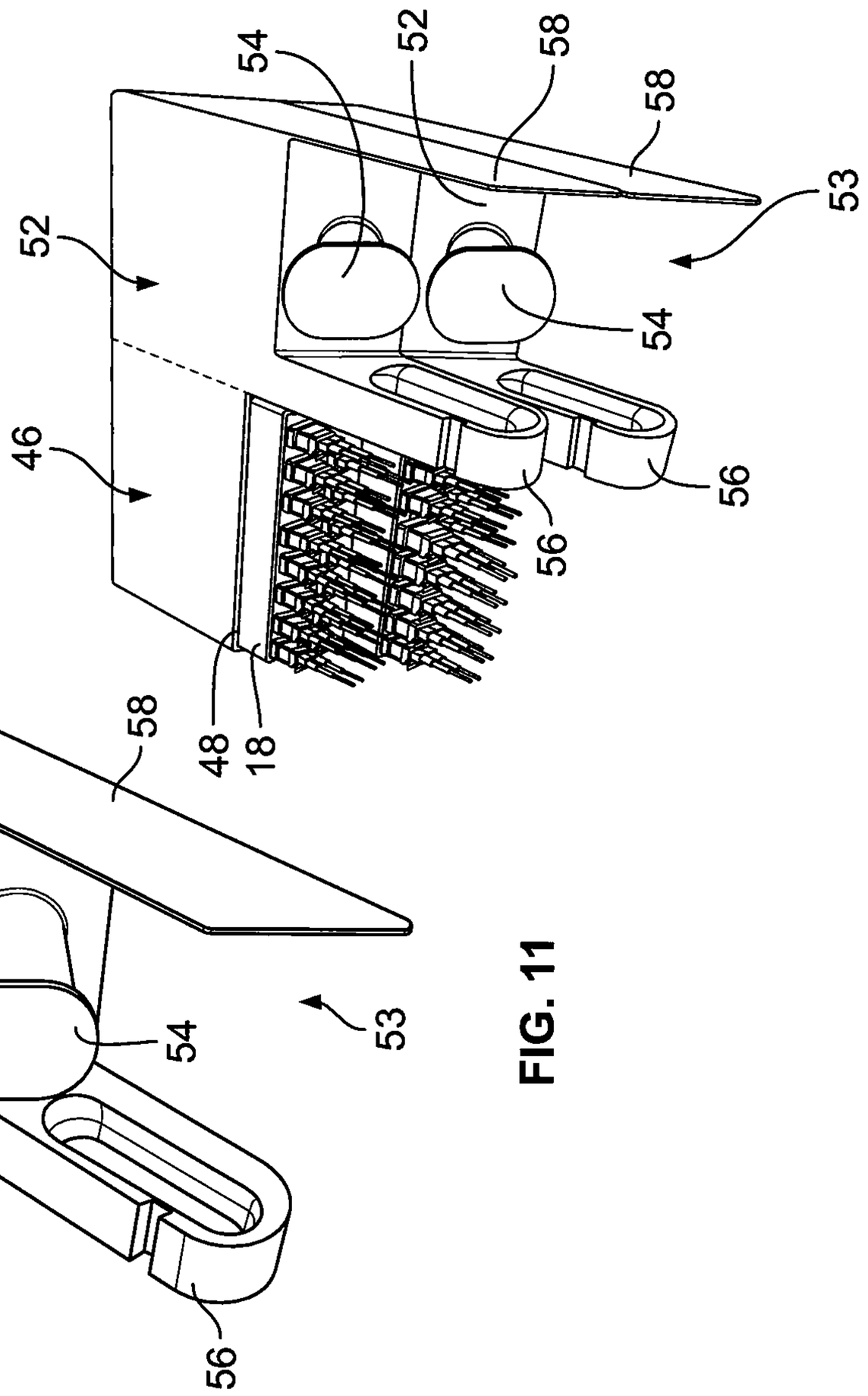

FIG. 12

FIG. 11

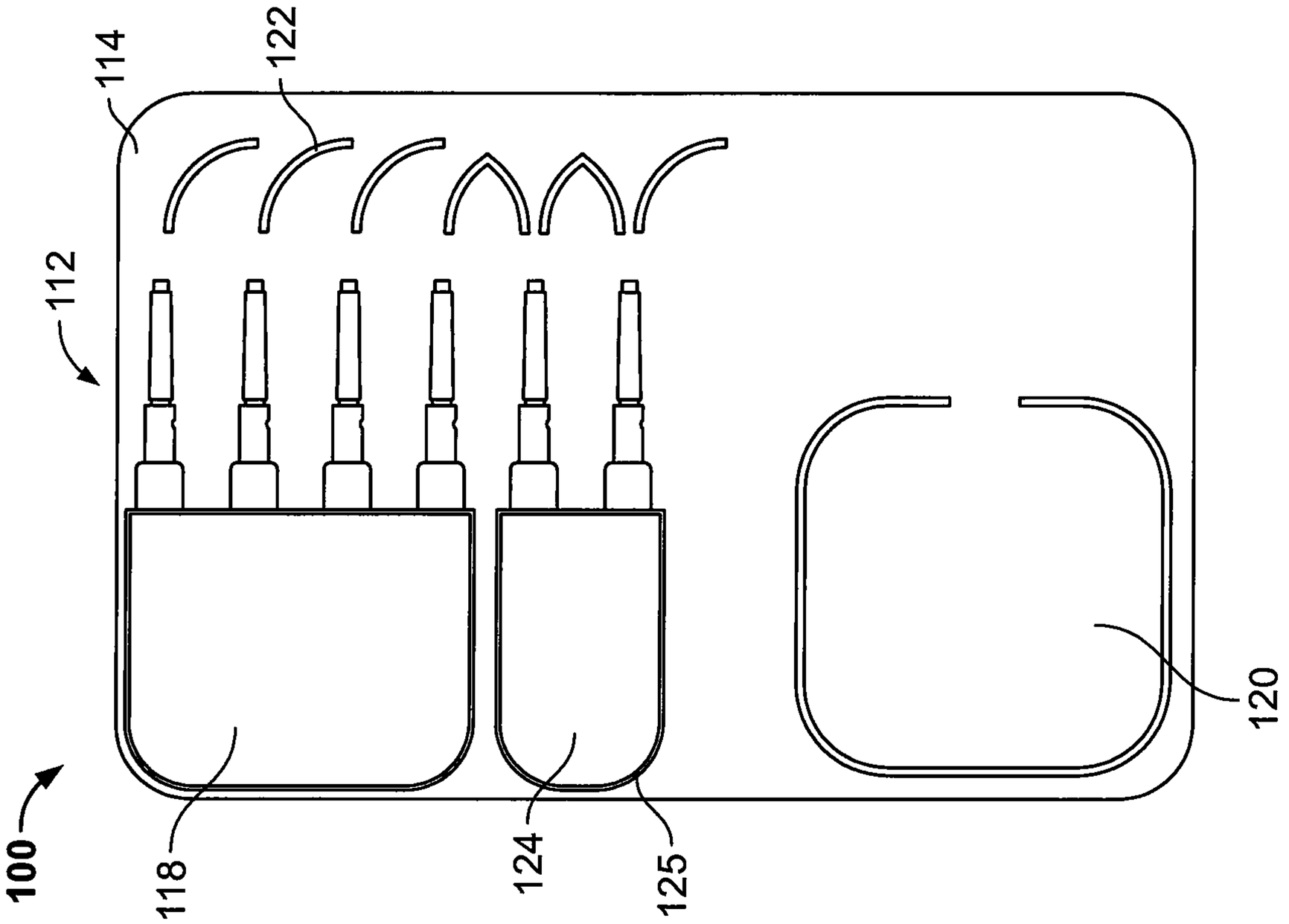
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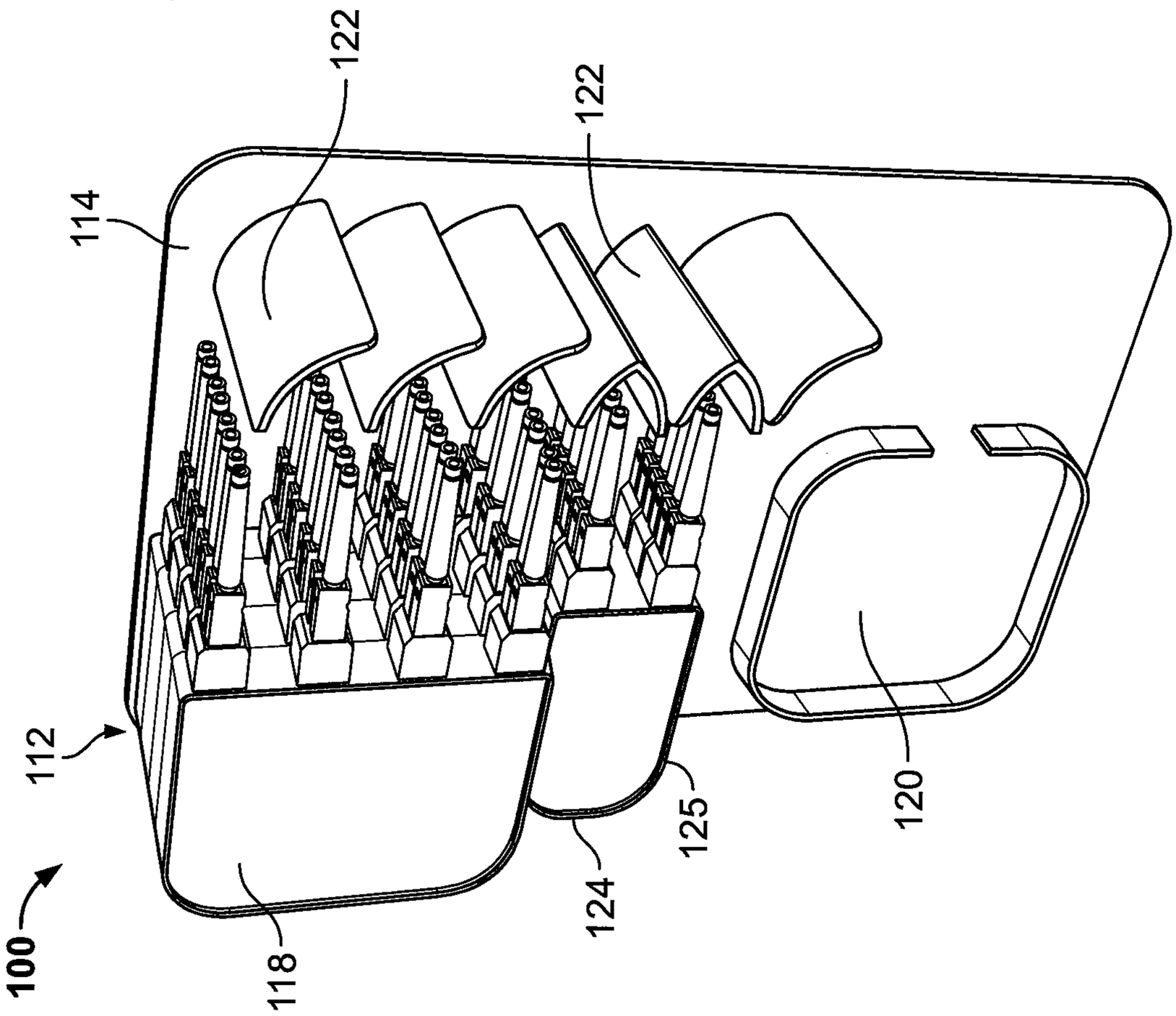
FIG. 15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120

FIG. 14

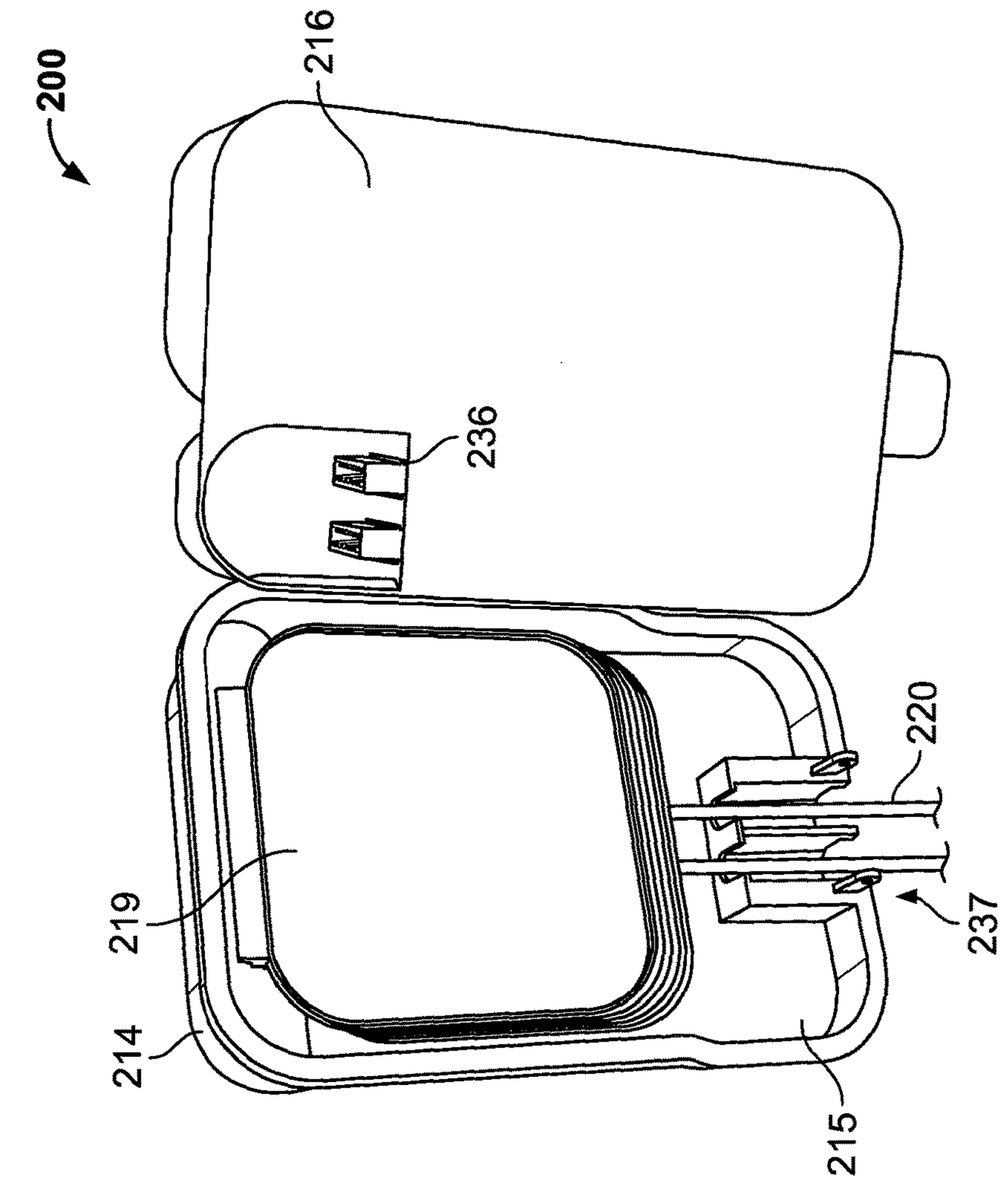

200
216
236
219
214
220
237
215

FIG. 17

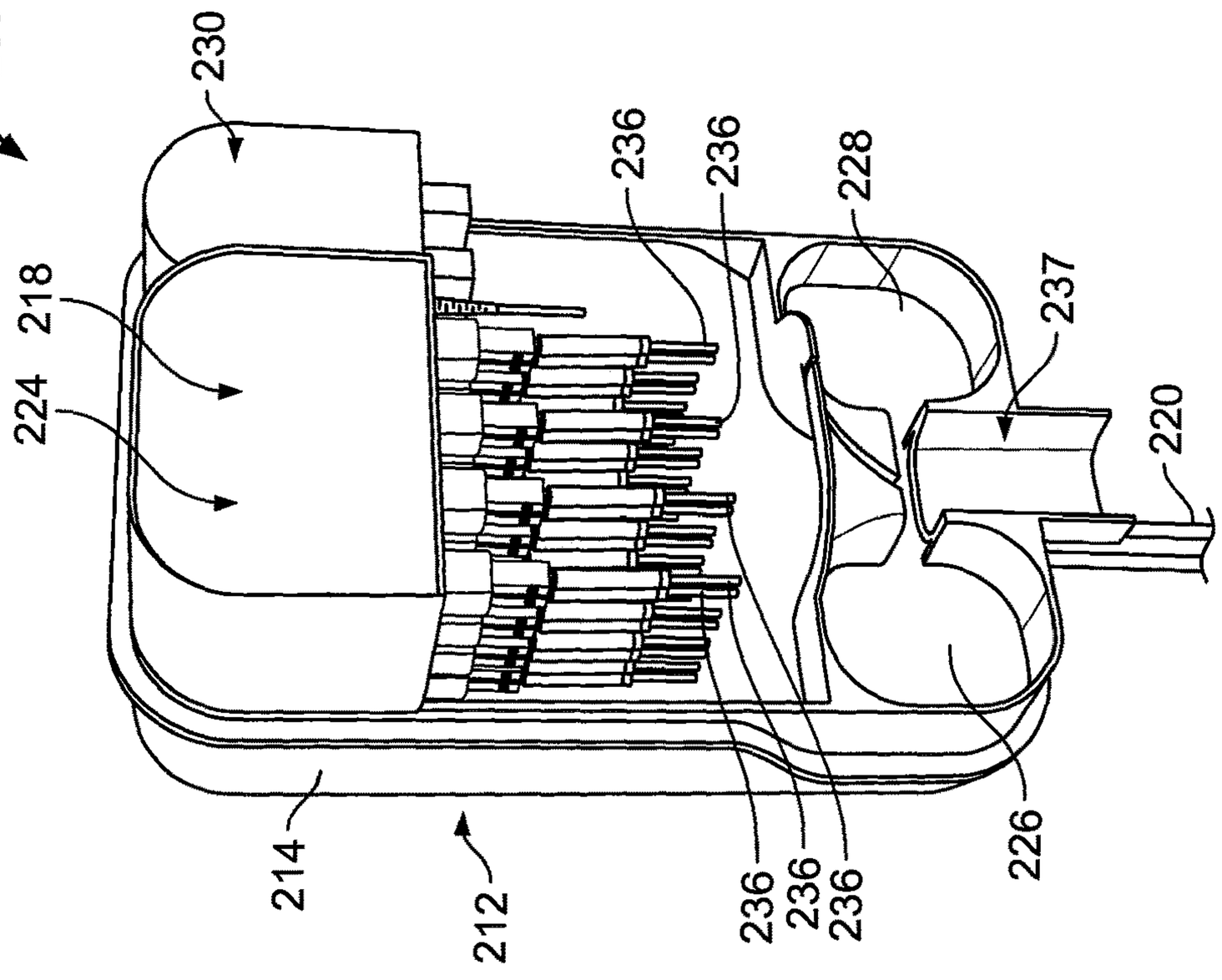

200
230
218
224
236
236
228
237
220
214
212
236
236
236
226

FIG. 16

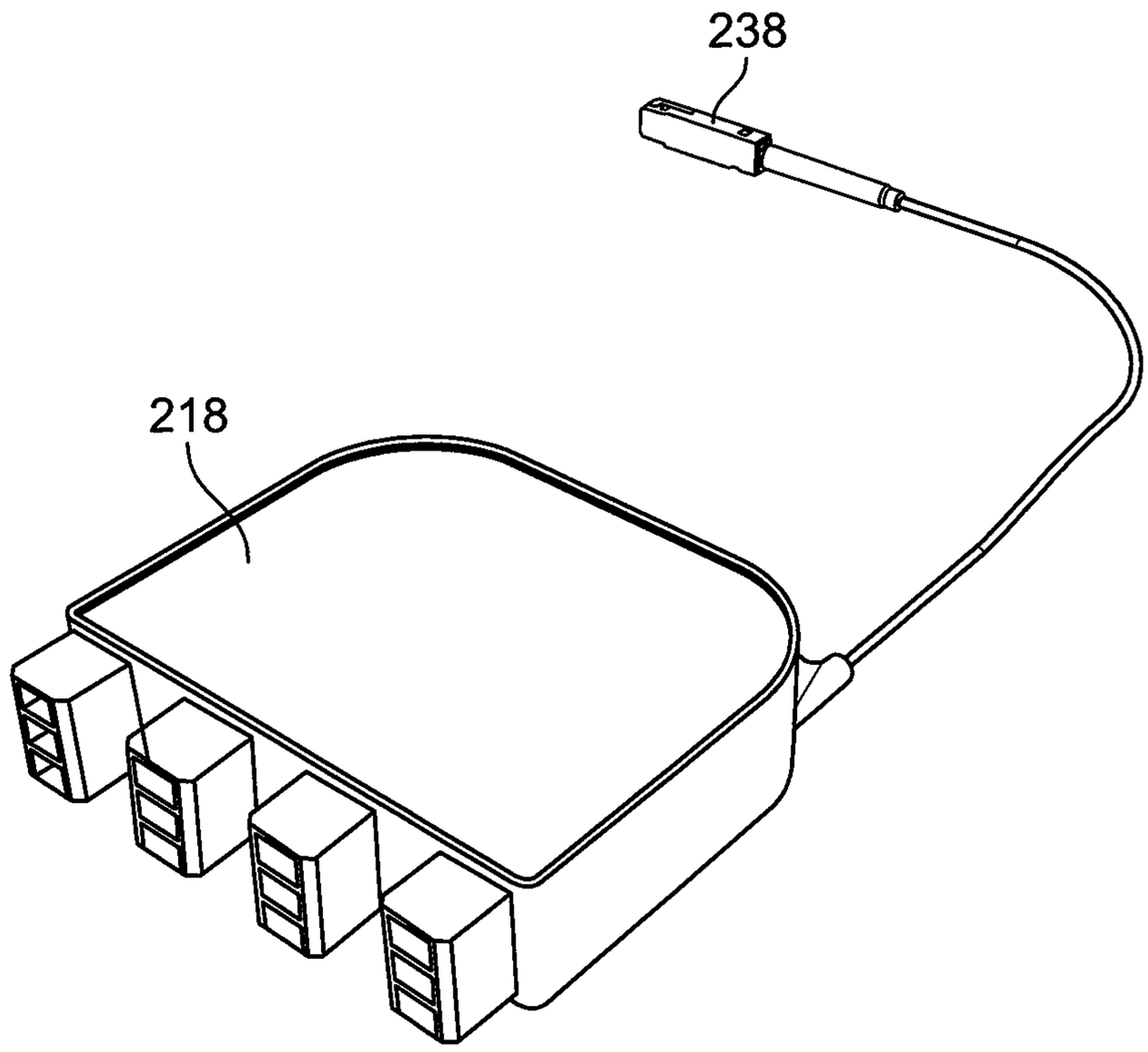


FIG. 18

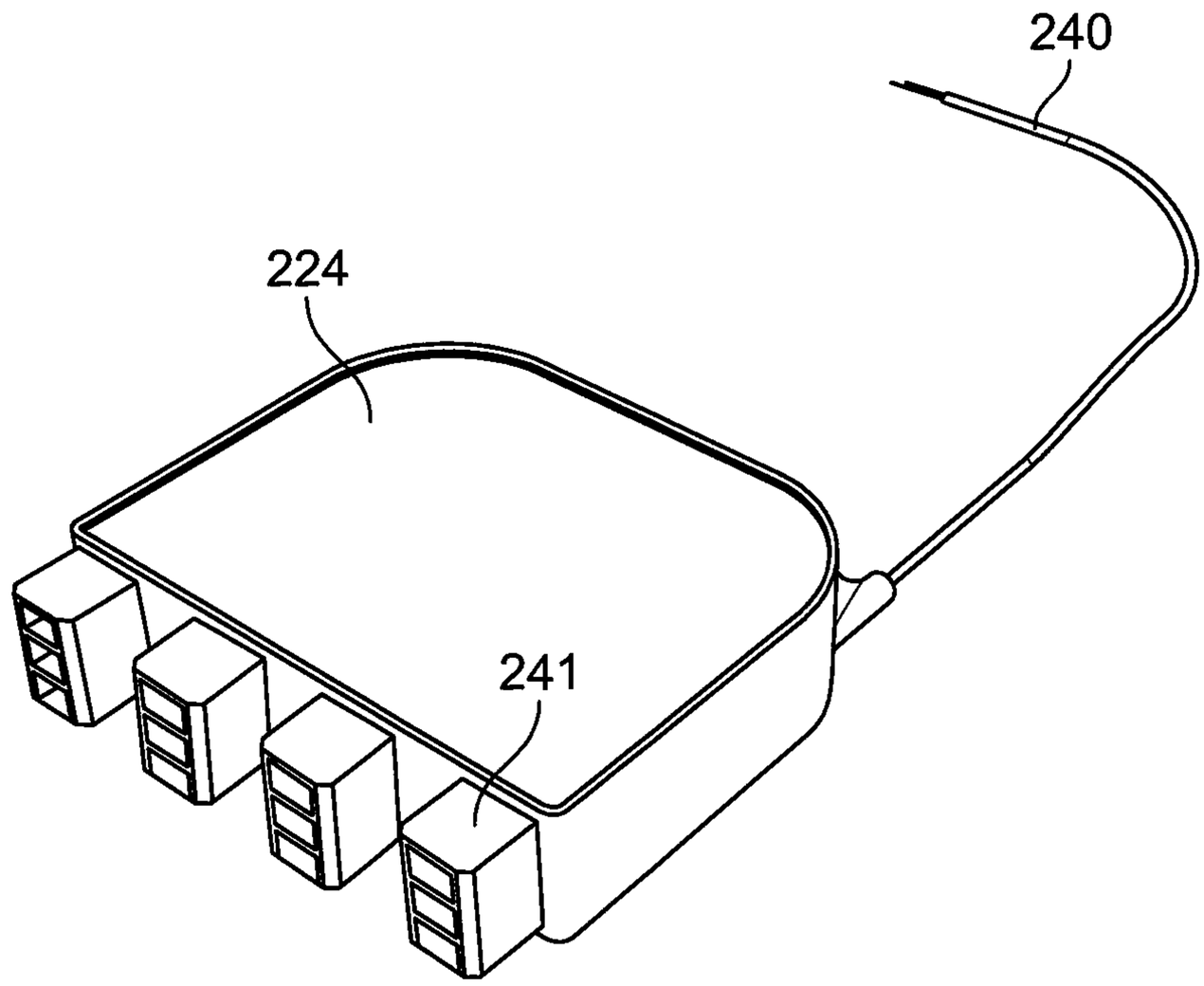


FIG. 19

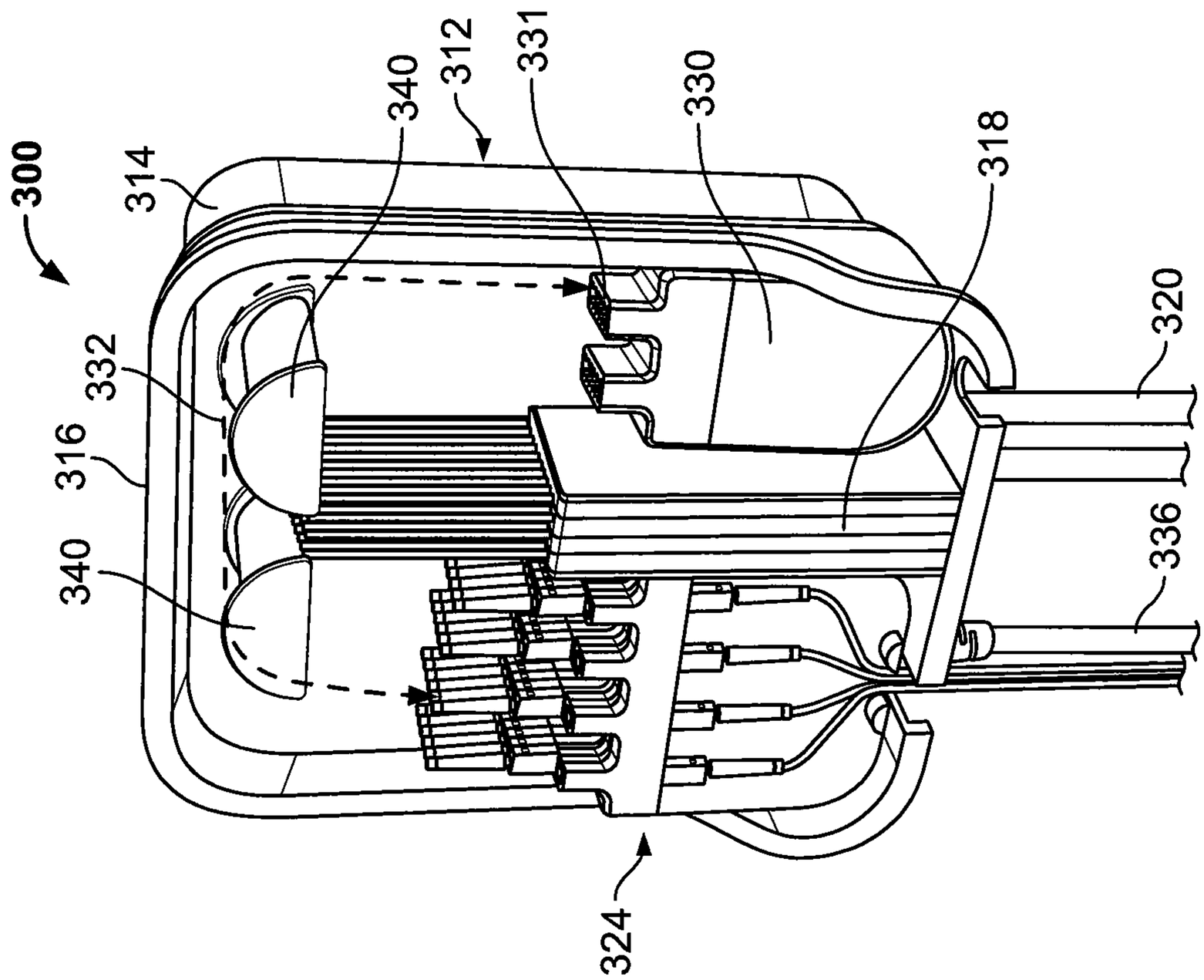

300
314
340
312
331
330
318
320
332
316
340
336
324

FIG. 21

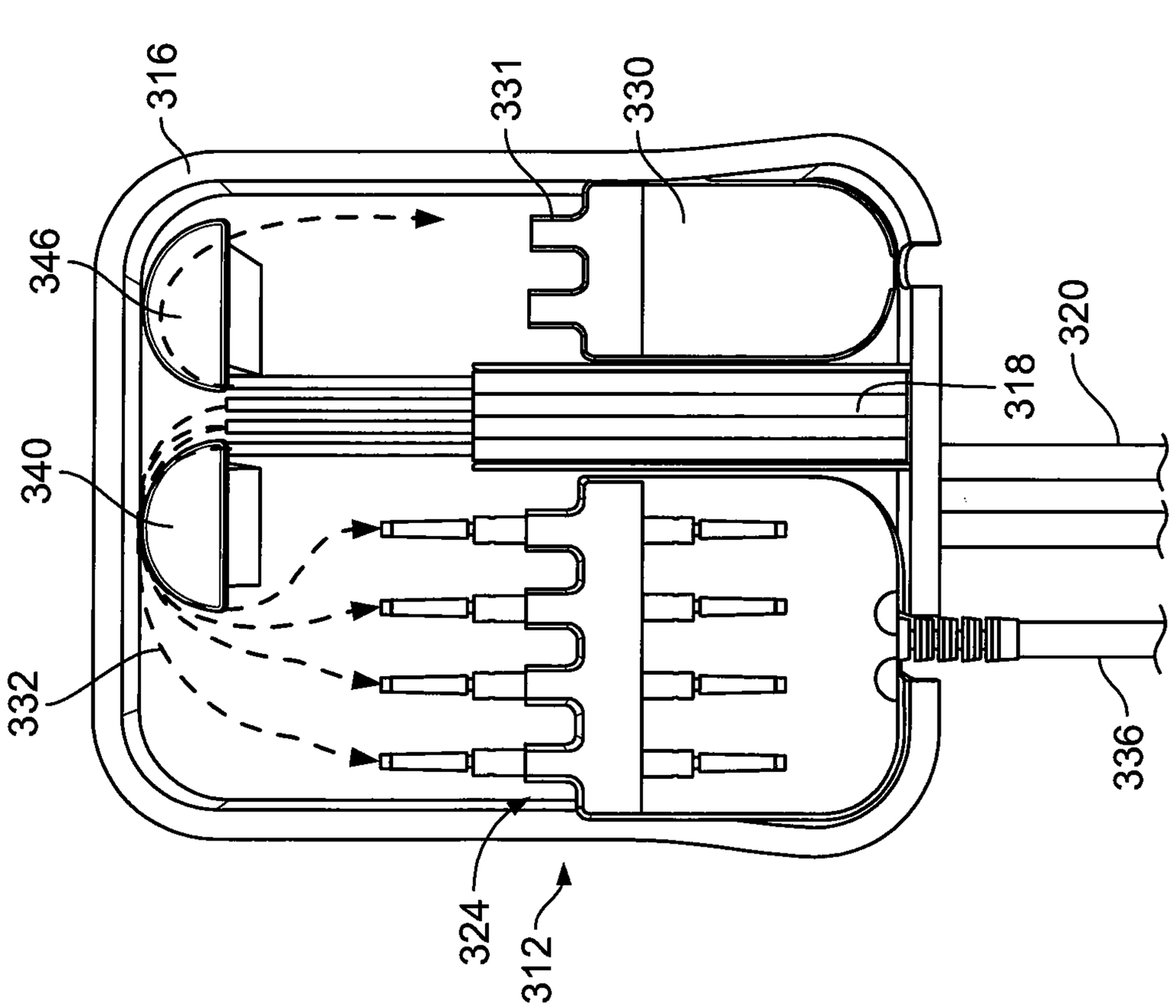

300
316
331
330
346
320
318
340
332
336
324
312

FIG. 20

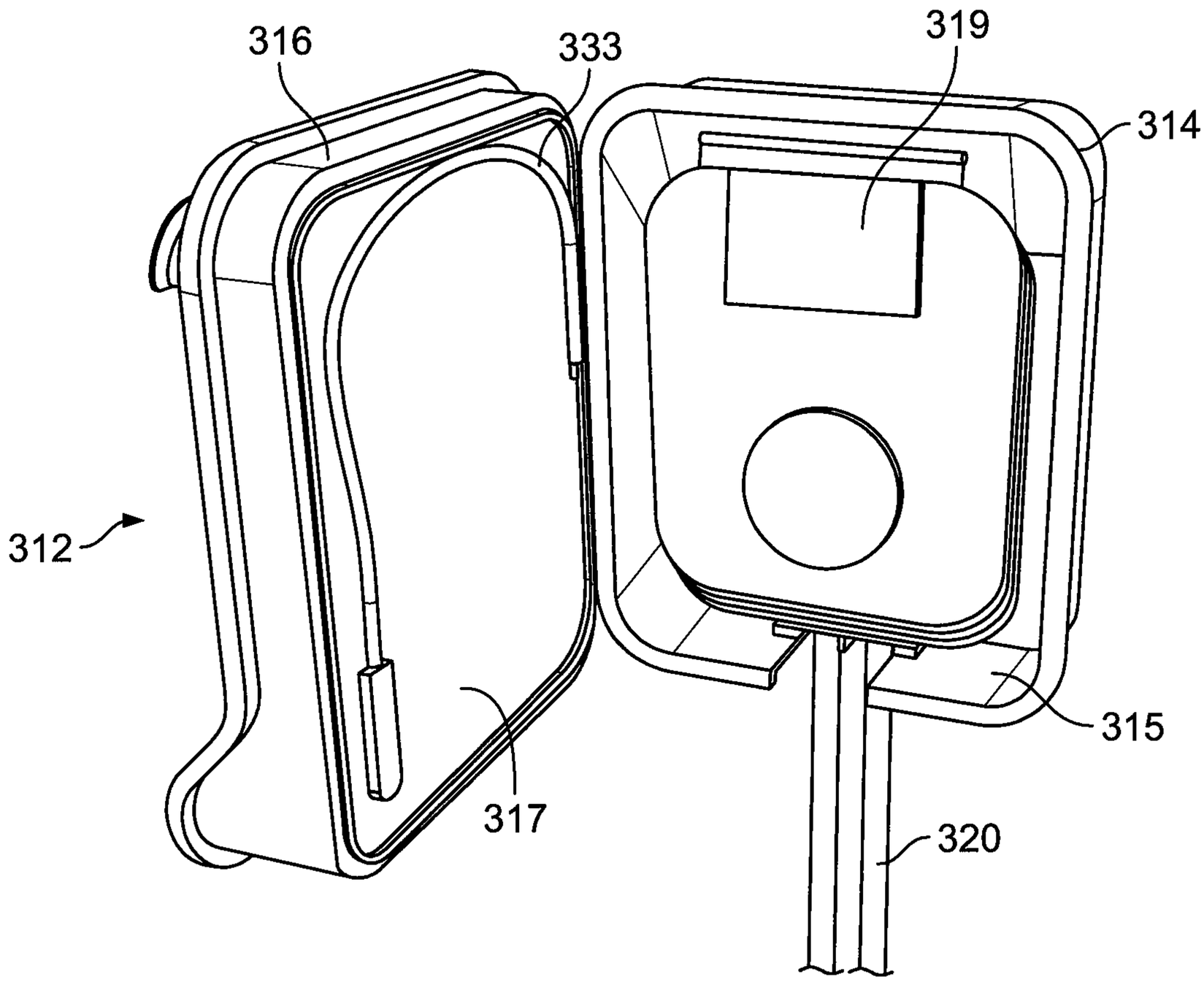


FIG. 22

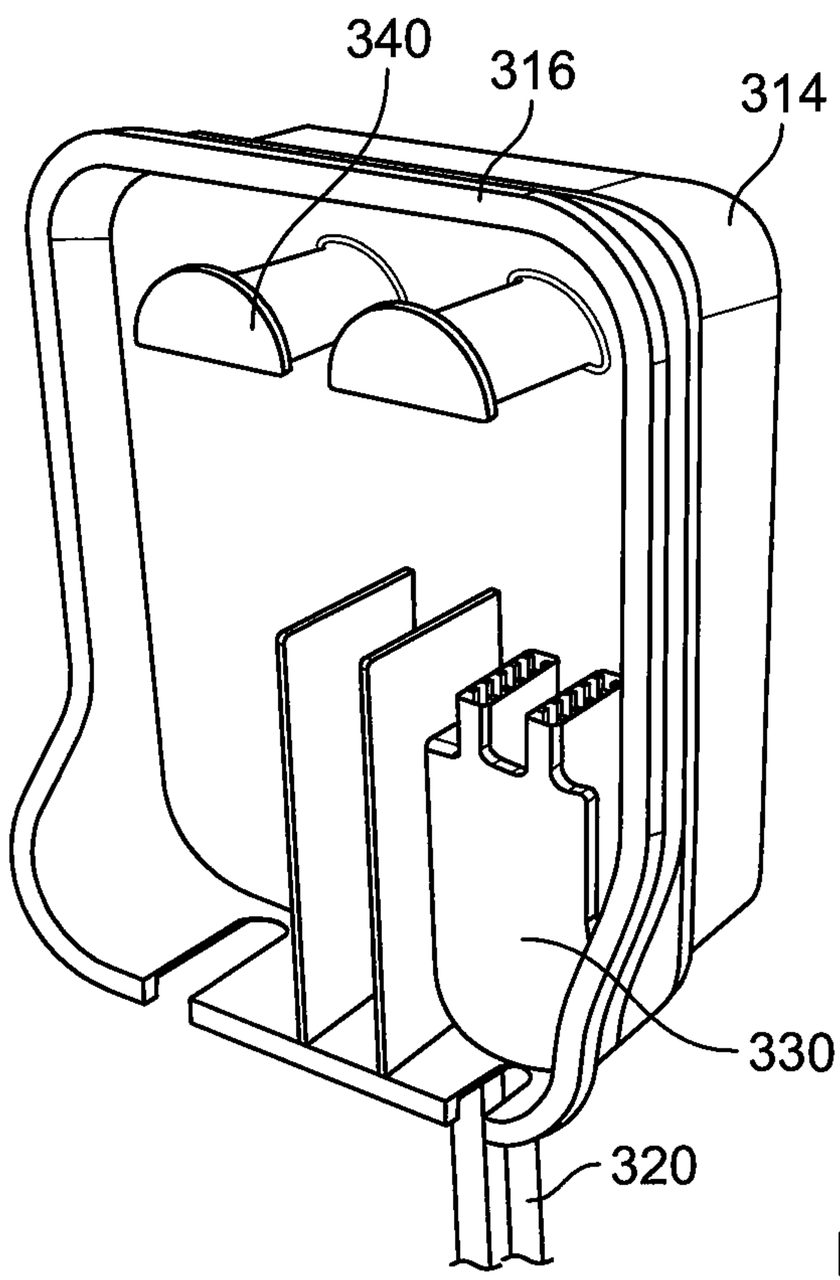


FIG. 23

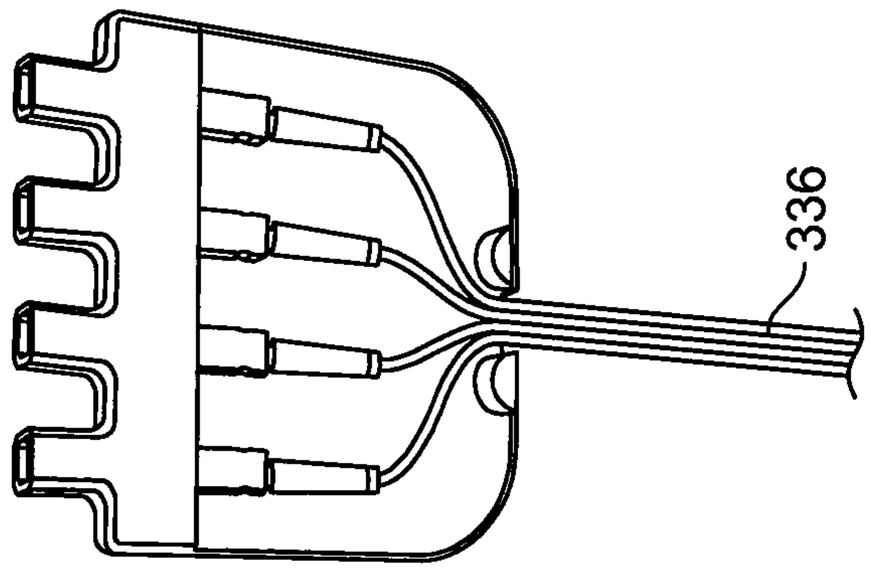
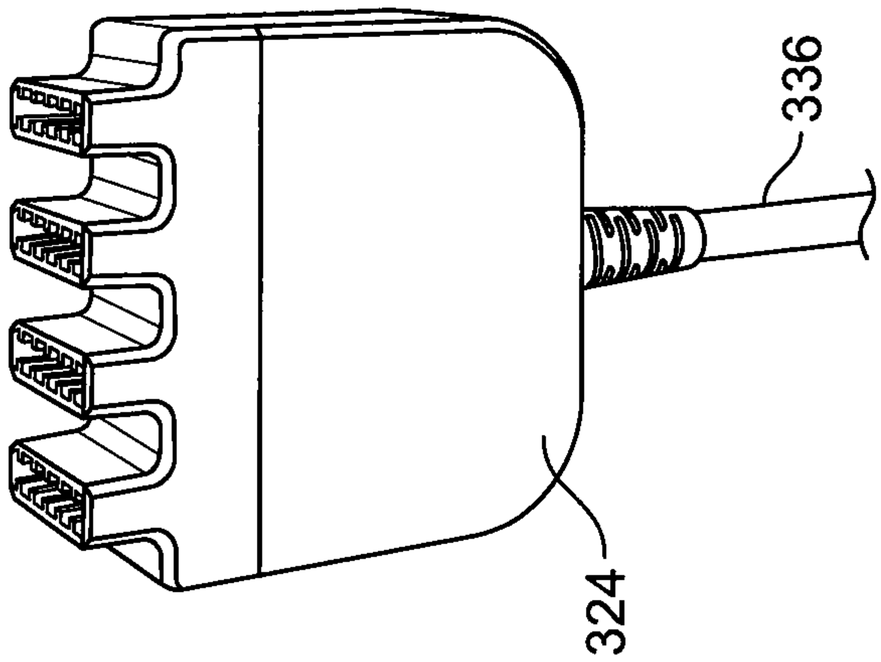


FIG. 25



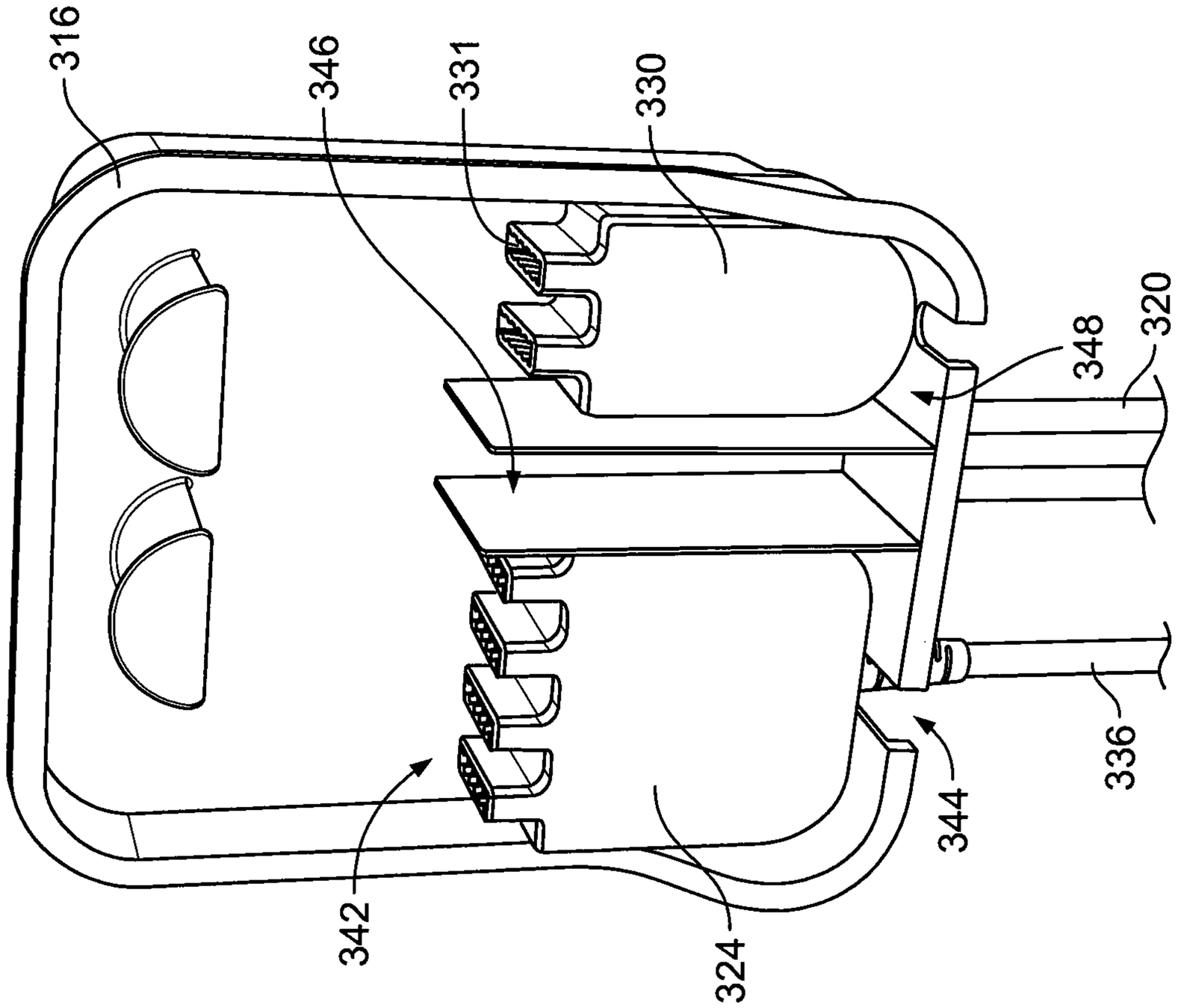


FIG. 24

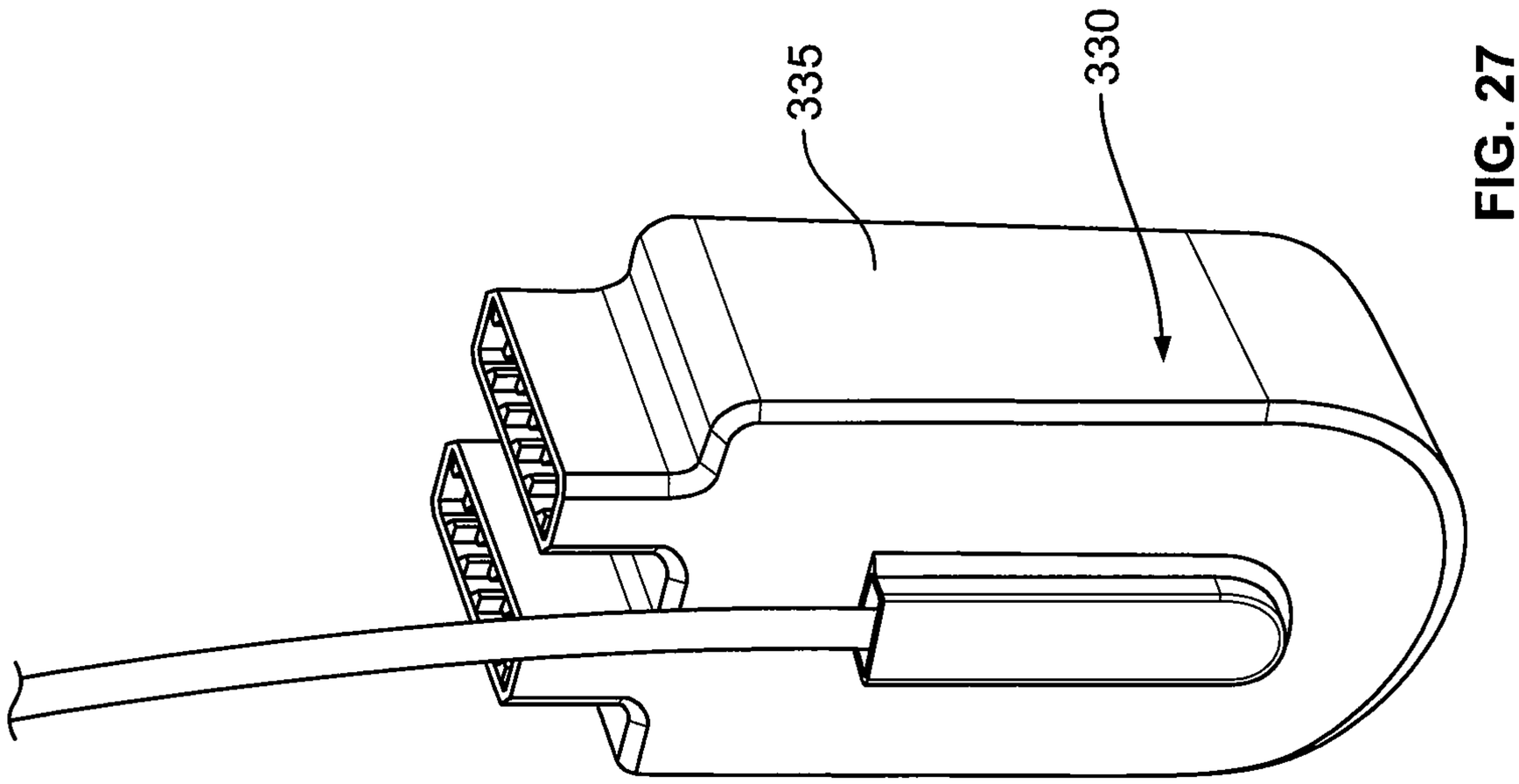


FIG. 27

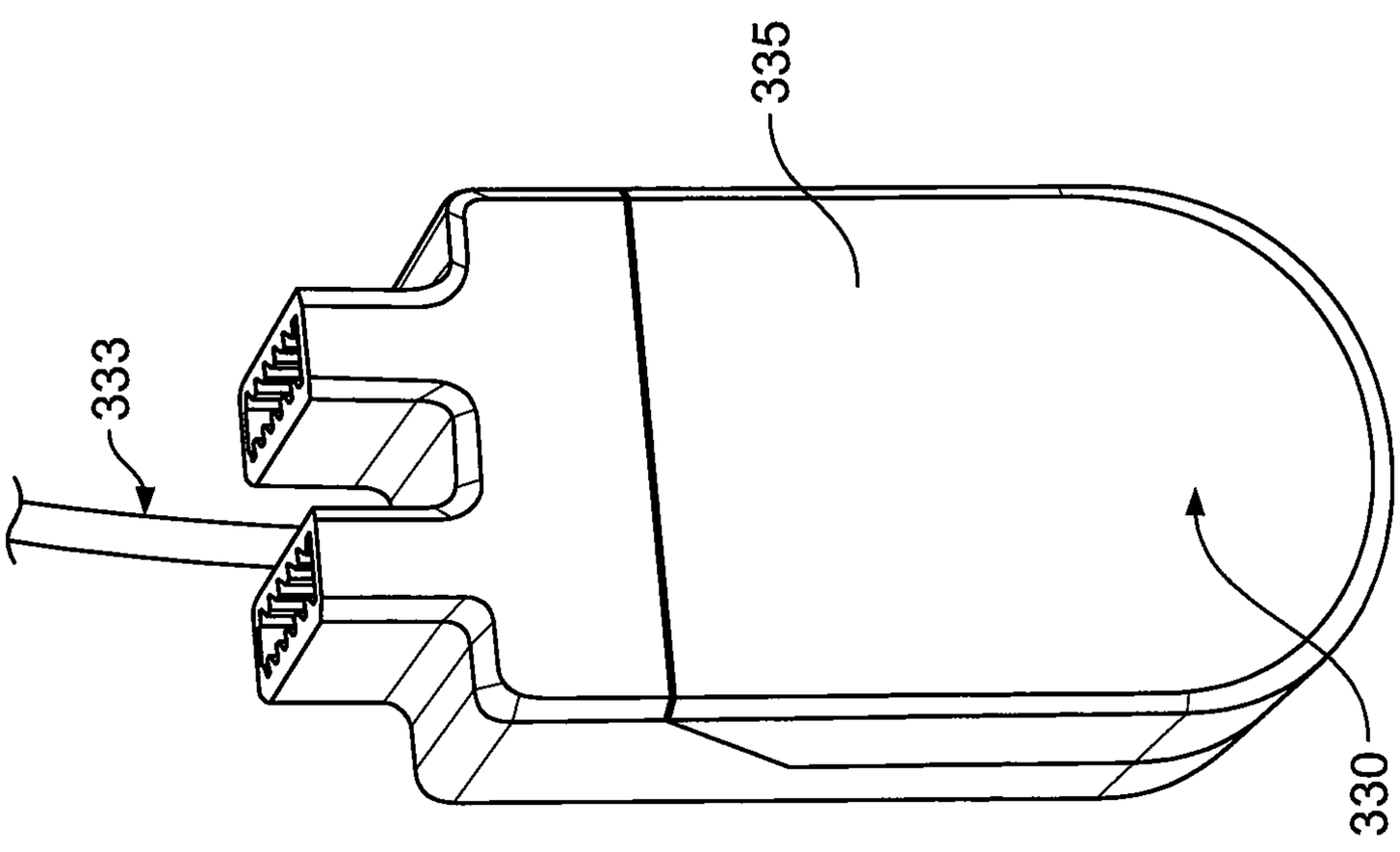


FIG. 26

CABLE DISTRIBUTION SYSTEM WITH FAN OUT DEVICES

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application Ser. No. 62/261,606, filed Dec. 1, 2015, which application is hereby incorporated by reference in its entirety.

BACKGROUND

As demand for telecommunications increases, fiber optic networks are being extended in more and more areas. In facilities such as multiple dwelling units (MDU's), apartments, condominiums, businesses, etc., fiber optic distribution terminals and boxes are used to provide subscriber access points to the fiber optic network. Cables are also used to interconnect the subscriber access points provided by the fiber distribution terminals with subscriber interface units (e.g., Optical Network Terminals) provided at subscriber locations (e.g., at each residence of an MDU). With respect to such fiber distribution systems, there is a need for techniques to effectively manage cables and optical splitters while also taking into consideration space constraints.

SUMMARY

A cable distribution system is provided wherein a feeder cable with one or more feeder fibers is received by a distribution terminal, device, or box. The feeder fibers are spliced to a feeder fan out device. Customers can directly connect to the feeder fan out device by patching between the feeder fan out device and a distribution fan out device that is spliced to a distribution cable. This connection creates a point-to-point connection. The number of fan out devices in the system can be increased as needed. Alternatively, a splitter input can be connected to the feeder fan out device, such as through a pigtail extending from the splitter, wherein the splitter splits the signal as desired into a plurality of outputs. The outputs of the splitters can be in the form of connectors or adapters. The connectors or adapters are then connected to the distribution fan out device and customers can receive a split signal through the distribution cable that is spliced with the distribution fan out device. The system allows for the use of un-connectorized distribution cables.

The cable distribution system allows for mixing of connection types to the customer(s) such as a direct connection (point-to-point), or a split signal connection. Further, the types of splitters can be mixed and varied as desired, such as 1×2, 1×4, 1×8, 1×16, 1×32, 2×4, etc., or other. Different combinations of splitters can be used in the distribution device, such as one or more 1×4 splitters, one or more 1×8 splitters, and/or one or more 1×16 splitters. Further the types of fan out devices can be mixed and varied as desired, such as fan out devices having 8, 16, 24, 32 outputs, etc., or other. Other combinations are possible.

The fan out devices and splitters can be stored in the system using a tower that is configured to receive a plurality of fan out devices or splitters. Adjacent the tower can be cable management modules that each include spools and together form a vertical trough that runs next to the tower.

The fan out devices and splitters can also be stored in a stacking arrangement. In such an arrangement, the fan out devices and splitters can be stacked on top of one another in an internal tray. The tray is then stacked on top of a base. The base is configured to hold a plurality of splice trays for splicing a feeder cable.

The fan out devices and splitters can also be stored in another stacking arrangement. In such an arrangement, the fan out devices and splitters can form multiple stacks in an internal tray. The tray is then stacked on top of a base that is configured to hold a plurality of splice trays for splicing a feeder cable. The system also includes an integral feeder port device that is spliced to the feeder cable and provides a plurality of outputs, effectively fanning out the feeder cable.

The inputs and outputs of the splitters and fan out devices can be in the form of connectors or adapters mounted at or within the device housings, or connectors or adapters on the ends of stubs extending from the housings. The stubs (semi-rigid) can improve density and improve connector and/or adapter access through movement of the stubs. Preferably the stubs are not so flexible that the stubs become easily tangled up with each other.

Protective covers may be provided for the overall device, the feeder cable, the fan out devices, any splices, and the splitters.

The connectors and adapters utilized in the cable distribution system can be any desired connection type, such as SC type, or LC type. MPO types may also be used. Another example is a connector and adapter system as shown in international patent publication Nos. WO2012/112344 and WO 2013/117598, the entire disclosures of which are hereby incorporated by reference. This connector and mating adapter may also be referred to as a LightPlug connector and adapter, or an LP connector and adapter, in the accompanying pages. The LightPlug connector system utilizes ferruleless connectors, with bare fiber to bare fiber connections. This connector type can be terminated to a bare fiber in the factory or in the field using a LightPlug termination tool. With respect to LightPlug connectors and adapters, some cost savings may be realized by adding the adapter at a later date when connectivity is desired. A hybrid adapter can be used to connect a ferruleless LightPlug connector to a ferruled connector, like an SC type.

Growing capacity may occur where the customer wants more splitters and point-to-point (double density) at the same location. Therefore, the number of fan out devices and splitters can be increased. Alternatively, a second box or cabinet can be mounted next to the initially installed box or cabinet; one un-used fiber bundle/tube from the feeder cable is routed to the new box or cabinet and the new box or cabinet can be installed similar to the first box. Depending on the feeder cable, more boxes or cabinets can be connected.

Growing capacity in another case can occur where the customer wants a second box at a nearby location. A second box can be mounted somewhere in the neighborhood; feeder fibers from un-used bundles/tubes are spliced to a feeder cable which runs to the second box; this spliced feeder stub enters the second box in the same way the feeder enters the first box. Depending on the feeder cable, more boxes can be connected in a daisy-chaining manner.

In one aspect of the present disclosure, a fiber distribution system is disclosed. The fiber distribution system includes a feeder cable and a base defining a breakout region. At the breakout region, a plurality of optical cables of the feeder cable can be accessed. The breakout region includes at least one splice tray. The fiber distribution system also includes at least one feeder fan out device that has a single input and a plurality of outputs. The single input of the at least one

feeder fan out device is spliced with the feeder cable. The fiber distribution system further includes at least one splitter that has a single input and a plurality of outputs. The single input of the at least one splitter is a connectorized end plugged into one of the outputs of the at least one fan out device. The fiber distribution system includes at least one distribution fan out device having a plurality of inputs and a single output. The plurality of inputs are configured to receive a connection from an output of the at least one feeder fan out device or an output of the at least one splitter. The single output of the at least one distribution fan out device is spliced with a distribution cable to provide a single service output.

In another aspect of the present disclosure, a fiber distribution system is disclosed. The fiber distribution system includes a base that defines a breakout region. The breakout region includes at least one splice tray. The fiber distribution system includes at least one feeder fan out device that has at least one input and a plurality of outputs. The at least one input of the at least one feeder fan out device is connectable with a feeder cable. The fiber distribution system includes at least one distribution fan out device that has a plurality of inputs and at least one output. The plurality of inputs are configured to receive a connection from an output of the at least one feeder fan out device. The at least one output of the at least one distribution fan out device is connectable with a distribution cable to provide a single service output.

In another aspect of the present disclosure, a method of assembling a fiber distribution system is disclosed. The method includes providing a feeder cable at a breakout region of a base and splicing or otherwise connecting the feeder cable to an at least one input of an at least one feeder fan out device, the at least one feeder fan out device having a plurality of outputs. The method includes connecting an at least one input of an at least one splitter with one of the outputs of the at least one feeder fan out device. The at least one input has a connectorized end and the at least one splitter has a plurality of outputs. The method includes providing a single service output at an at least one output of an at least one distribution fan out device, the at least one distribution fan out device including a plurality of inputs. The plurality of inputs are configured to receive a connection from an output of the at least one feeder fan out device or an output of the at least one splitter.

A variety of additional aspects will be set forth in the description that follows. The aspects can relate to individual features and to combinations of features. It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the broad inventive concepts upon which the embodiments disclosed herein are based.

BRIEF DESCRIPTION OF THE DRAWINGS

The following drawings are illustrative of particular embodiments of the present disclosure and therefore do not limit the scope of the present disclosure. The drawings are not to scale and are intended for use in conjunction with the explanations in the following detailed description. Embodiments of the present disclosure will hereinafter be described in conjunction with the appended drawings, wherein like numerals denote like elements.

FIG. **1** shows a schematic view illustrating a fiber distribution system showing feeder fibers first spliced to a fan out device and then connected to either splitter outputs or to fan-out inputs for point-to-point outputs, according to one embodiment of the present disclosure;

FIG. **2** shows a distribution box or cabinet of the fiber distribution system of FIG. **1**;

FIGS. **3** and **4** show example splitters of the fiber distribution system of FIG. **1**, the splitters being 1×16 splitters;

FIGS. **5** and **6** show example fan out devices of the fiber distribution system of FIG. **1**;

FIG. **7** shows an example storage tower along with example splitters and fan out devices, according to one embodiment of the present disclosure;

FIG. **8** shows the example tower of FIG. **7** mounted to a base of the distribution box or cabinet;

FIGS. **9** and **10** show the distribution box or cabinet of FIG. **2**, including cable management modules of the fiber distribution system;

FIGS. **11**, **12**, and **13** show example cable management modules of the distribution box or cabinet of FIG. **2**;

FIG. **14** and FIG. **15** show a distribution box or cabinet of a fiber distribution system, according to one embodiment of the present disclosure;

FIG. **16** and FIG. **17** show a distribution box or cabinet of a fiber distribution system that utilizes a stacked arrangement, according to one embodiment of the present disclosure;

FIG. **18** shows an example splitter of the fiber distribution system of FIGS. **16** and **17**, the splitter being a 1×8 splitter;

FIG. **19** shows an example fan out device of the fiber distribution system of FIGS. **16** and **17**, the fan out device including twelve outputs;

FIG. **20** and FIG. **21** show a distribution box or cabinet of a fiber distribution system according to one embodiment of the present disclosure, the system utilizing a stacked arrangement and being configured for use with pre-connectorized distribution cables;

FIG. **22** shows the distribution box or cabinet of FIGS. **20** and **21** with an internal cover removed from a base;

FIG. **23** shows the distribution box or cabinet of FIGS. **20** and **21** with an internal cover installed on the base;

FIG. **24** shows the internal cover of the distribution box or cabinet of FIGS. **20** and **21**;

FIG. **25** shows example fan out devices of the fiber distribution system of FIGS. **20** and **21**; and

FIGS. **26** and **27** show example feeder port devices of the fiber distribution system of FIGS. **20** and **21**.

DETAILED DESCRIPTION

Various embodiments will be described in detail with reference to the drawings, wherein like reference numerals represent like parts and assemblies throughout the several views. Reference to various embodiments does not limit the scope of the claims attached hereto. Additionally, any examples set forth in this specification are not intended to be limiting and merely set forth some of the many possible embodiments for the appended claims.

Referring now to FIGS. **1-27**, a distribution box or cabinet receives a feeder cable with one or more feeder fibers. The feeder cable is first spliced and then taken to a feeder fan out device that separates the individual optical fibers of a multi-fiber feeder cable. From the outputs of the fan out device, each fiber can then be connected to either a splitter, for a split output, or wired as a point-to-point connection to a distribution fan out device. The fibers, coming from either the splitters or feeder fan out device, can then be connected to another fan out device or to a splice, and distributed as un-connectorized distribution cables.

A variety of splitter and fan out devices are shown having housings mounted to distribution boxes or cabinets. The splitters used are for splitting of the signals of the fanned out feeder fibers. Within the interior of the splitter, the splitter input is split into a plurality of outputs. The distribution box can hold one or more splitters and fan out devices. The preferred distribution box or cabinet allows for: 1) split outputs of a splitter input cable connected at the termination field; 2) point-to-point connection with an output cable at the termination field; or 3) both split feeder signal and point-to-point feeder signals. FIG. **1** shows this schematically.

Referring further to FIG. **1**, the schematic representation of a distribution system **10** includes a distribution box or cabinet **12** shown offering both point-to-point **14** and split output **16** connections for the feeder cable **20** to the service users. The feeder cable **20** is shown entering a splice **22** and then connected to a feeder fan out device **24**. The feeder fan out device **24** provides a plurality of outputs **26**, which can be connected to either an input **28** of a splitter **18** or an input **30** of a distribution fan out device **25** using a patch cable **32**. Each patch cable **32** is connectorized at either end. At one end, each patch cable **32** either connects to an output **26** of the feeder fan out device **24** or a splitter output **34**. At the other end, the patch cables **32** connect to the input **30** of the distribution fan out device **25**. The distribution fan out devices **25** then output a cable that is spliced **35** to un-connectorized distribution cables **36**. The un-connectorized distribution cables **36** are then routed out of the distribution box or cabinet **12** to the customer.

FIG. **2** shows the system **10** in the distribution box or cabinet **12**. Each component can be organized within the distribution box or cabinet **12** so as to allow the system to be customized for particular applications. This allows the user to use similar components for a variety of differently sized applications. System **10** allows for the later addition of splitters **18** and/or fan out devices **24/25** to delay early cost if the system is small to start. At a later date, if the system **10** needs to expand, splitters and fan-outs can be added.

FIGS. **3** and **4** show perspective views of the splitters **18**. The splitter **18** shown includes sixteen outputs **34** spaced so as to allow for the easy connecting and removal of patch cables **32**. However, other sized splitters can also be used with more outputs or less outputs. The splitter outputs **34** can be SC or LC connectors, in addition to multi-fiber connectors, such as MPO connectors. The splitters can include port identifiers, a splitter identifier, and an RFID tag, if desired. The splitter inputs **28** are connected to the outputs **26** of the fan out device **24**, which is where the feeder cable **20** is spliced. The splitter **18** takes the feeder cables and splits them into splitter outputs. The splitter outputs **34** are shown as fiber optic connectors disposed within the housings of each splitter **18**. The patch cable **32** is connectorized with a mating connector and a mating adapter for connecting to the splitter outputs **34** within the inputs **30** of the distribution fan out devices **25**. Each splitter **18** has a housing **19** that is configured to allow the splitter **18** to fit within the distribution box or cabinet **12**.

FIG. **5** shows the feeder fan out device **24**. The feeder fan out device **24** receives an input cable **38** from the splice **22**. The feeder fan out device **24** operates to separate the individual optical fibers of a multi-fiber feeder cable **20** in a manner such that the fibers are not damaged so as to maintain a quality transmission link. As shown, the feeder fan out device outputs **26** are shown as fiber optic connectors disposed within housings **40** of each fan out device **24**. The feeder fan out device **24** includes twenty-four outputs **26** spaced so as to allow for the easy connecting and removal of patch cables **32**. However, the fan out device **24** can be configured with more or less outputs. The outputs **26** can be SC or LC connectors, in addition to multi-fiber connectors, such as MPO connectors. The feeder fan out device **24** can include port identifiers, a splitter identifier, and an RFID tag, if desired. The patch cable **32** is connectorized with a mating connector and a mating adapter for connecting to the fan out device outputs **26** within the splitter inputs **28** (split signal) or the inputs **30** of the distribution fan out devices **25** (point-to-point connector). Each fan out device **24** has a housing **40** that is substantially similar to the housing of the splitter **18**. The housings **40** are configured to allow the fan out device **24** to fit within the distribution box or cabinet **12**.

FIG. **6** shows the distribution fan out device **25**. The distribution fan out device **25** receives a plurality of inputs **30** and outputs to a cable **42** that is routed to the splice **35**. The distribution fan out device **25** is similar to the feeder fan out device **24**, except that it operates in an opposite manner. The distribution fan out device **25** includes thirty-two inputs **30** spaced so as to allow for the easy connecting and removal of patch cables **32**. However, the distribution fan out device **25** can be configured with more or less outputs. The inputs **30** can be SC or LC connectors, in addition to multi-fiber connectors, such as MPO connectors. The distribution fan out device **25** can include port identifiers, a splitter identifier, and an RFID tag, if desired. The distribution fan out device **25** also includes a housing **44** that is substantially similar to the housing **19** of the splitter **18** and the housing **40** of the feeder fan out device **24**.

FIG. **7** shows a schematic illustration of a portion of the system **10**. A tower **46** is shown that is configured to fit within the distribution box or cabinet **12**. As shown, the tower **46** includes six slots **48**. Each slot **48** is configured to receive and secure either a fan out device **24/25** or a pair of splitters **18**. In other embodiments, the tower **46** can be configured to include more or less slots **48**. Additionally, each slot **48** can be sized differently to include a plurality of different fan out/splitter arrangements. For example, each slot **48** can be configured to hold a pair of fan out devices **24/25**. The tower **46** can also be loaded with components as needed, and then expanded or shrunk after installation to meet the needs of the application. In some embodiments, the tower **46** can be modular, and individual slots **48** can be added or removed as needed.

FIG. **8** shows the tower **46** with fan out devices **24/25** and splitters **18** installed in the slots **48**. As shown, the feeder fan out device **24** includes twenty-four outputs **26**. Six splitters **18** are shown installed in three slots. Each splitter includes sixteen outputs **34**. Further, each of the pair of distribution fan out devices **25** includes thirty-two inputs **30**. As shown, the tower **46** is mounted to the box or cabinet **12**. In some embodiments, the box or cabinet **12** has a width W of about 500 mm and a height H of about 500 mm.

FIGS. **9** and **10** show the system **10** assembled in the distribution box or cabinet **12**. As shown on one side of the distribution box or cabinet **12**, the splices **22**, **35** are positioned in a splice tower **50**. The splice tower **50** can include a plurality of splice trays. In the depicted embodiment, the splice tower **50** includes twelve splice trays. Also shown near the splice tower **50** are the distribution cables **36** that are un-connectorized. By using un-connectorized distribution cables **36**, it allows the user flexibility and cost savings as there is no need to connectorize the distribution cables **36** in the field.

The tower **46** is positioned on the opposite side of the distribution box or cabinet **12**. Adjacent the tower **46** is a vertical stack of cable management modules **52**. The mod-

ules **52** create a vertical trough **53** so as to organize cabling (such as patch cables **32**) connecting the fan out devices **24/25** with the splitters **18**.

FIGS. **11-13** show the modules **52**. In some embodiments, the modules **52** are positioned adjacent the tower **46**. As shown in FIG. **11**, each module **52** includes a cable spool **54**, a cable arm **56**, and a wall portion **58**. FIGS. **12-13** show a pair of modules **52** stacked on top of one another adjacent two slots **48** of the tower **46**. In some embodiments, the module **52** can also be connected to a single slot **48**, thereby forming a tower module with cable management. Multiple tower modules can be assembled to create a tower with an integrated cable management solution. Alternatively, the modules **52** can be stacked adjacent a separately fabricated tower **46** to create a similar solution.

The modules **52** are configured to first allow cables to pass through and over the cable arm **56**. The cable arm **56** supports cabling passing therethrough, and keeps the cabling from sagging. Once passed through the cable arm **56**, the spool **54** of each module **52** is configured to house any slack left in the cables. The cables can then be routed in the vertical trough **53** so as to allow cabling to travel to other components of the system **10**. For instance, a patch cable **32** can be routed from a splitter **18** to a fan out device **24/25** by traveling from the splitter **18**, to the vertical trough **53**, and then back over to the fan out device **24/25**. The modules **52** allow the front of the tower **46** to stay free of excess cabling. This allows the user to quickly and easily find connectors on the splitters **18** and the fan out devices **24/25** during service and installation.

FIG. **14** shows a distribution system **100** mounted in a distribution box or cabinet **112** according to another embodiment of the present disclosure. The system **100** includes similar components of the system **10**, but positioned slightly differently. Further, the system **100** can operate in a similar manner as the system **10** above. The system **100** is configured to receive a feeder cable (not shown) and splice the feeder cable to at least one fan out device **124**. The fan out device **124** is then connected to either a splitter **118** (for a split signal) or directly to a distribution fan out device **125** (for a point-to-point connection). Finally, un-connectorized distribution cables (not shown) are output from the system **100**. As shown, the distribution box or cabinet **112** includes a base **114**. Mounted to the base **114** are a plurality of splitters **118** and a plurality of fan out devices **124/125**. The base **114** also includes one or more storage areas **120**. The storage area **120** can be used for cable slack, unused feeder cables or for splice tray storage. Further, the system **100** includes cable guides **122**, so as to help guide and organize cabling within the system traveling from the fan out devices **124** to the splitters **118**.

Referring now to FIGS. **16** and **17**, an alternative system **200** with a distribution box or cabinet **212** is shown. The system **200** includes similar components of the system **10** and **100**, but is orientated slightly differently. The distribution box or cabinet **212** can include a cover (not shown), a base **214**, and an internal cover **216** used for cable routing and storage. The base **214** includes a storage area **215** to hold and house a plurality of splice trays **219**. Feeder cables **220** pass through a channel **237** and enter the splice trays **219**. The internal cover **216** is positioned over the splice and storage area **215** of the base **214**. In some embodiments, the internal cover **216** can be hinged to base **214**. In other embodiments, tabs and snaps are used to mount the internal cover **216** to the base **214**. The internal cover **216** can include an area to store a plurality of fan out devices **224** and/or splitters **218**. Further, the internal cover **216** includes one or more storage areas **226**, **228**. The left side storage area **226** can be used to store dark fibers or unused fibers. The right side storage area **228** can be used to store active fibers. Both the left and right sides **226**, **228** can be used to store splice holders.

The spliced feeder cables **220** can enter the internal cover **216** through feeder ports **230**. From the feeder ports **230**, cables can travel to a fan out device **224**. From the fan out device **224**, cables can then travel to either a splitter **218**, which can be stacked with the fan out device **224**, or cables can be output to the customer in the form of a distribution cable **236** for a point-to-point connection. If the cables travel to a splitter **218**, the signal is then split and the multiple distribution cables **236** can be connected to the outputs of the splitter to achieve a split signal to multiple customers.

In other embodiments, the feeder ports **230** can instead function as fan out devices **224**. In such an embodiment, the fan out devices **224** are positioned adjacent the stack of splitters **218** within the distribution box or cabinet **212**. From the fan out device **224**, cables can then be run either to the splitters **218** for a split signal output, or cables can run directly out of the box of cabinet **212** through the channel **237** in the form of distribution cables **236**.

FIGS. **18** and **19** show an example splitter **218** and an example fan out device **224**. As shown, the splitter **218** is has a connectorized input **238**. The input **238** is configured to connect with the output **241** of the fan out device **224**. In FIG. **19**, an input **240** of the fan out device **224** is shown to be non-connectorized and is configured to be spliced with feeder cable **220** at the splice trays **219**. The splitter **218** and fan out device **224** can be of a variety of different size for a variety of different applications. In some embodiments, the splitter **218** and the fan out device **224** are stackable on top of one another. In other embodiments, the splitter **218** and fan out device **224** are configured to be placed side-by-side within the box or cabinet **212**. The splitter and fan out inputs and outputs can be SC or LC connectors, in addition to multi-fiber connectors, such as MPO connectors. The splitters **218** and fan out devices **224** can include port identifiers, a splitter identifier, and an RFID tag, if desired.

FIGS. **20-24** show an alternative system **300** with a distribution box or cabinet **312**. The system **300** includes similar components of the systems **10**, **100**, and **200**; however, the system **300** is configured to be used with pre-connectorized distribution cables **336**. The distribution box or cabinet **312** can include a cover (not shown), a base **314**, and an internal cover **316**. The base **314** includes a storage area **315** to hold and house a plurality of splice trays **319**. Feeder cables **320** enter into the base **314** and are spliced at a plurality of splice trays **319**. The internal cover **316** is positioned over the splice and storage area of the base **314**. In some embodiments, tabs and snaps are used to mount the internal cover **316** to the base **314**. The internal cover **316** can include an area to store a plurality of fan out devices **324**, splitters **318**, and feeder port devices **330**.

In the depicted embodiment, the system **300** receives the feeder cables **320** at the base **314** of the box or cabinet **312**. The cables **320** are then spliced with an input **333** of at least one feeder port device **330**. The feeder port devices **330** can operate as a fan out device, thereby separating the individual fibers of the feeder cable **320** and providing an output connector **331** for each fiber of the feeder cables **320**.

From the outputs **331** of the feeder port devices **330**, patch cables **332** can connect to either to an input of one splitter **318** or connect to a fan out device **324**. Additional splitters **318**, fan out devices **324**, and feeder port devices **330** can be added at a later date after the initial installation, as desired.

This helps defer costs. If connected to the splitter **318**, a split signal will be produced, and the output of the splitter **318** will be connected to the input of the fan out device **324** and will exit out of the distribution box or cabinet **312** as a multi-fiber distribution cable **336**, similar to the system **10**. This connection example is shown by the dotted lines in FIG. **20**. Alternatively, if the patch cables **332** connect the outputs **331** of the feeder port devices **330** to the fan out device **324**, a point-to-point connection is made. This connection example is shown by the dotted lines in FIG. **21**. Further, the box or cabinet **312** also includes cable management devices **340** to help to manage the patch cables **332** within the interior of the box or cabinet **312**.

FIG. **22** shows the distribution box or cabinet **312** with the internal cover **316** partially removed from the base **314**. FIG. **23** shows the distribution box or cabinet **312** with the internal cover **316** covering the base **314**. As shown, at least one feeder port device **330** is pre-installed in the internal cover **316**. The input **333** of the feeder port device **330** is shown to be positioned at back side **317** of the internal cover **316**, and positioned to be spliced with the feeder cables **320** at the splice tray **319**.

FIG. **23** shows the internal cover **316**. The internal cover **316** can have a plurality of storage areas. In one area **342**, a plurality of fan out devices **324** can be stored. Additionally, the storage area **342** can also include an exit slot **344** for the distribution cables **336**. As shown in FIG. **25**, the distribution cables **336** are pre-connectorized with fan out devices **324**. The fan out devices **324** can be slid into the box **312** while the cable **336** exits the box **312** through the exit slot **344**.

A second storage area **346** can be used to store a plurality of splitters **318**, and a third storage area **348** is used to store a plurality of feeder port devices **330**.

FIGS. **26** and **27** show the feeder port device **330** of the system **300**. As shown, the input **333** enters a backside of a housing **335** of the feeder port device **330**.

In some embodiments, a second box substantially similar to box **312** can be mounted somewhere in the neighborhood, near box **312**. Unused feeder-fibers can be spliced back into a feeder cable and run to the second box. The second box can operate identical to the box **312**. Depending on the feeder cable, more boxes can be connected in a daisy-chaining manner.

As noted, various implementations of the systems **10**, **100**, **200**, **300** are provided for adding capacity over time. One implementation is to add the splitters or fan out devices as needed over time. Another implementation for adding capacity uses two distribution boxes. Splitters from the second distribution box can be connected to point-to-point connections of the first distribution box. Another implementation for adding capacity includes a feeder cable connected to two (or more) distribution boxes as desired. This provides additional feeder connections to customers directly, or through splitters. Another implementation for increasing capacity includes adding a second (or more) distribution box at a remote location, wherein a further feeder cable is spliced to the first feeder cable to link the two distribution boxes. Another implementation in systems **200** and **300** is to add a new additional internal cover **216**, **316** to the distribution box or cabinet **212**, **312** to add increased outputs through the use of larger splitters.

The various embodiments described above are provided by way of illustration only and should not be construed to limit the claims attached hereto. Those skilled in the art will readily recognize various modifications and changes that may be made without following the example embodiments and applications illustrated and described herein, and without departing from the true spirit and scope of the following claims.

We claim:

1. A fiber distribution system comprising:

a system housing including a base;

a feeder cable;

the base defining a breakout region at which a plurality of optical cables of the feeder cable can be accessed, the breakout region including at least one splice tray;

at least one feeder fan out device including a feeder fan out device housing mounted to the system housing, the at least one feeder fan out device further including at least one input and a plurality of outputs, the plurality of outputs being at least one of connectors or adapters mounted in the feeder fanout device housing of the at least one feeder fan out device, the at least one input of the at least one feeder fan out device being spliced or otherwise connected with the feeder cable;

at least one splitter including a splitter housing mounted to the system housing, the at least one splitter further including at least one input and a plurality of outputs, the plurality of outputs being at least one of connectors or adapters mounted in the splitter housing of the at least one splitter, wherein the at least one input of the at least one splitter includes a connectorized end plugged into one of the outputs of the at least one feeder fan out device; and

at least one distribution fan out device including a distribution fan out device housing mounted to the system housing, the at least one distribution fan out device further including a plurality of inputs and at least one output, the plurality of inputs being at least one of connectors or adapters mounted in the distribution fan out device housing of the at least one distribution fan out device, wherein the plurality of inputs are configured to receive a connection directly from an output of the at least one feeder fan out device or an output of the at least one splitter, and wherein the at least one output of the at least one distribution fan out device is spliced or otherwise connected with a distribution cable to provide a single service output.

2. The fiber distribution system of claim **1**, wherein the base includes a modular tower having a plurality of slots, the slots being configured to receive the at least one feeder fan out device, the at least one splitter, and the at least one distribution fan out device.

3. The fiber distribution system of claim **2**, wherein the base also includes cable management modules positioned adjacent the tower, each cable management module including a spool and a cable arm configured to hold cables horizontally, and wherein a plurality of cable management modules define a vertical trough for vertical cable management.

4. The fiber distribution system of claim **1**, wherein the system housing includes a permanently mounted cabinet.

5. The fiber distribution system of claim **1**, wherein the system housing includes a fiber distribution box.

6. The fiber distribution system of claim **1**, wherein the at least one feeder fan out device, the at least one splitter, and the at least one distribution fan out device are positioned with one another at a first storage area of the system, and wherein the feeder cable, the distribution cable, and general cable storage are positioned at a second storage area of the system.

7. The fiber distribution system of claim 6, wherein the first storage area is positioned side by side next to the second storage area.

8. The fiber distribution system of claim 6, wherein the system housing includes an internal cover configured to cover the base, wherein the first storage area is in the internal cover, and wherein the second storage area is in the base.

9. The fiber distribution system of claim 8, wherein the internal cover is connected by a hinge to the base.

10. The fiber distribution system of claim 8, wherein the at least one splitter is positioned adjacent to the at least one distribution fan out device and at least one feeder fan out device in the first storage area.

11. A fiber distribution system comprising:

a system housing including a base defining a breakout region, the breakout region including at least one splice tray;

at least one feeder fan out device having at least one input and a plurality of outputs, the at least one input of the at least one feeder fan out device being connectable with a feeder cable, the plurality of outputs of the at least one feeder fan out device being at least one of connectors or adapters; and

at least one distribution fan out device including a distribution fan out device housing mounted to the system housing, the at least one distribution fan out device further including a plurality of inputs and at least one output, the plurality of inputs being at least one of connectors or adapters mounted in the distribution fan out device housing of the at least one distribution fan out device, wherein the plurality of inputs are configured to receive a connection directly from an output of the at least one feeder fan out device, and wherein the at least one output of the at least one distribution fan out device is connectable with a distribution cable to provide a single service output.

12. The fiber distribution system of claim 11, wherein the base includes a modular tower having a plurality of slots, the slots being configured to receive the at least one feeder fan out device and the at least one distribution fan out device.

13. The fiber distribution system of claim 12, wherein the base also includes cable management modules positioned adjacent the tower, each cable management module including a spool and a cable arm configured to hold cables horizontally, and wherein a plurality of cable management modules defines a vertical trough for vertical cable management.

14. The fiber distribution system of claim 11, wherein the system housing includes a permanently mounted cabinet.

15. The fiber distribution system of claim 11, wherein the system housing includes a fiber distribution box.

16. The fiber distribution system of claim 11, wherein the at least one feeder fan out device and the at least one distribution fan out device are positioned with one another at a first storage area of the system, and wherein the system includes a second storage area for general cable storage.

17. The fiber distribution system of claim 16, wherein the first storage area is positioned side by side next to the second storage area.

18. The fiber distribution system of claim 16, wherein the system housing includes an internal cover configured to cover the base, wherein the first storage area is in the internal cover, and wherein the second storage area is in the base.

19. The fiber distribution system of claim 11, further comprising at least one splitter having at least one input and a plurality of outputs, wherein the at least one input of the at least one splitter includes a connectorized end plugged into one of the outputs of the at least one feeder fan out device and wherein the plurality of inputs of the distribution fan out device are configured to receive a connection from the output of the at least one feeder fan out device or an output of the at least one splitter.

20. A method of assembling a fiber distribution system comprising:

providing a feeder cable at a breakout region of a base of a system housing;

splicing or otherwise connecting the feeder cable to an at least one input of an at least one feeder fan out device, the at least one feeder fan out device including a feeder fan out device housing mounted to the system housing and having a plurality of outputs, the plurality of outputs being at least one of connectors or adapters mounted in the feeder fan out device housing of the at least one feeder fan out device;

connecting an at least one input of an at least one splitter with one of the plurality of outputs of the at least one feeder fan out device, the at least one splitter including a splitter housing mounted to the system housing, the at least one input of the at least one splitter having a connectorized end and the at least one splitter having a plurality of outputs, the plurality of outputs of the at least one splitter being at least one of connectors or adapters mounted in the splitter housing of the at least one splitter; and

providing a single service output at an at least one output of an at least one distribution fan out device, the at least one distribution fan out device including a distribution fan out device housing mounted to the system housing, wherein the at least one distribution fan out device includes a plurality of inputs, the plurality of inputs being at least one of connectors or adapters mounted in the distribution fan out device housing of the at least one distribution fan out device, wherein the plurality of inputs are configured to receive a connection directly from an output of the at least one feeder fan out device or an output of the at least one splitter.

21. The method of claim 20, further comprising splicing or otherwise connecting the at least one output of the at least one distribution fan out device with a distribution cable to provide the single service output.

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